Motorship

Registered in U. S. Patent Office and abroad

"A National Trade Journal"

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"A National Trade Journal"

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High Cargo-Ship Speeds

IN November, 1919, when post war sea trade was at its peak, MOTORSHIP, with an eye to the future pointed out that the low fuel consumption of Diesel power meant a new era in ocean shipping. Diesels would make high cargo-ship speeds an economic possibility, as the necessary fuel for 15 and 16 knots would not encroach upon the freight space as it would with a steamer of the same speed.

American shipowners have been slow to appreciate this, and the Wilson regime Shipping Board missed its opportunity. But, European owners forged ahead along these lines, and now are getting the cream of our export business by reason of the faster services offered.

Ten years ago MOTORSHIP published the following table:—

Cargo Vessels of About 14,000 Tons Loaded Displacement, or 9,500 Tons D.W.

Speed and Power
(*Year's average*)

Loaded speeds	11 knots	12 knots	14 knots	16 knots
Indicated Horsepower.	3,000	4,000	6,500	9,000

Daily Fuel Consumption

	Tons	Tons	Tons	Tons
Diesel motorship	9¼	12¾	20¾	29
Turbine oil-fired vessel.....	32	42¾	70	69¼
Reciprocating coal-burner..	49¾	66¼	107¾	149¼

Cargo vessels have since increased in size, and eventually will be of greater tonnage for certain routes, but the above comparison figures are still of interest.

Today a 16-knot, 14,000 tons d.w. steamer and motorship will have daily fuel consumptions of 120 tons and 45 tons respectively. A 20-day supply including reserve would mean 2400 tons of bunkers plus 350 tons of boiler water for the steamer compared with 900 tons of bunkers for the motorship. This does not count two weeks port fuel consumption which would be 200 tons and 15 tons additional respectively. How the steamer's fuel and water requirements encroaches on the cargo tonnage is obvious. The express motorship is a commercial feasibility, while the other is economically impossible. Next month we shall completely review the express cargo-liner situation. We have some remarkable figures and facts to place before our readers.

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Volume XIII *October, 1928* *Number 10*

Giant Motorliner in New York

Augustus, of the Italian Line, 32,650 tons Gross, 28,000 Shaft Horsepower, on Maiden Visit

Illustrated with First Main Engine Room Pictures Published

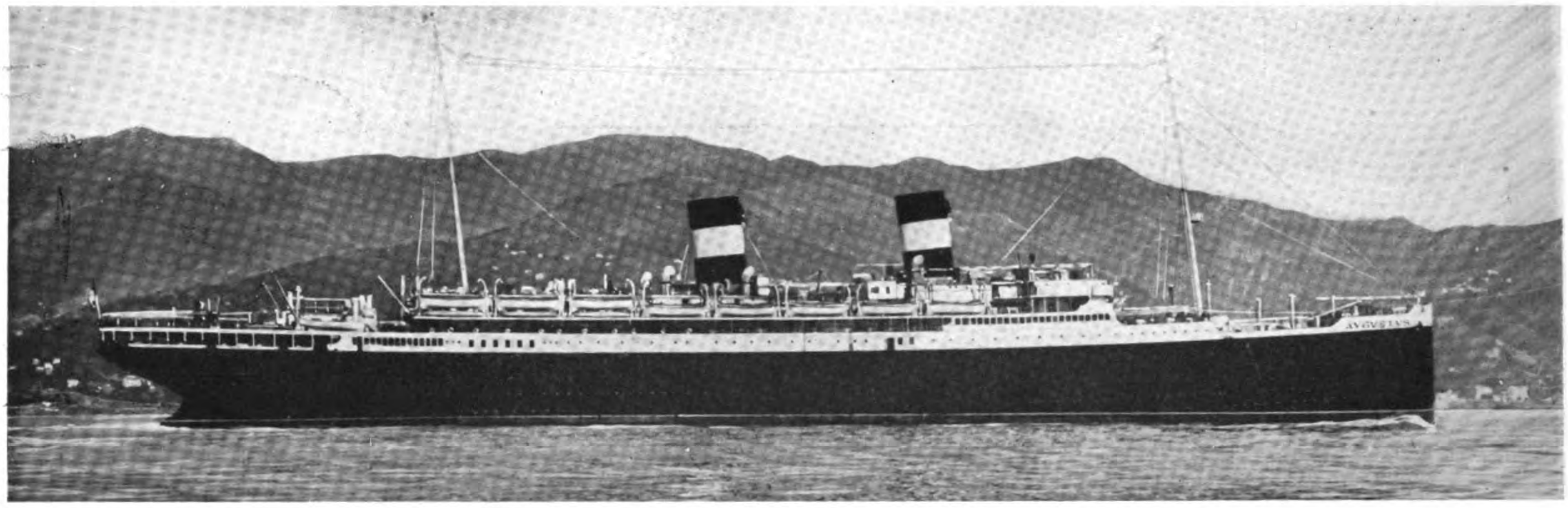
AUGUSTUS, the big, powerful passenger motorship of the N. G. I. Line, entered a United States port for the first time last month, making her debut in the North Atlantic-Mediterranean service after several voyages between her home port and South America.

Scheduled to remain in the North Atlantic passenger trade with the s.s. ROMA of the same line she will offer to passengers for Southern Europe the combination of sea comfort and speed with sumptuousness and service that was for so long monopolized by the liners on the northern service to the French and British ports on the English Channel.

AUGUSTUS would be a notable passenger liner even without the distinction of being the leader of the world's motorships. Her big size, large power and fine furnishings would make her the star vessel in every port of the globe, outside of New York and Southampton, and would give her preëminence on every trade route in the world except on the Lane of the Big Six. She lorded it over the large, elegant British, German and French liners that make Rio Janeiro and Buenos Aires. She is the biggest vessel those ports have ever seen, the biggest ship ever in South American waters. So, too, would she outvie all other vessels on every other sea and in every other port and under every other flag if she should leave the North Atlantic.

AUGUSTUS is a very big vessel. Even in such a port as

Through the kind courtesy of the N. G. I. Line, MOTORSHIP *was enabled to invite a number of men prominent in financial and shipping circles to a dinner in the main dining room of the Augustus, followed by an inspection of the ship. At the left table: General A. C. Dalton, Vice-President, United States Fleet Corporation; Captain A. Ruspini of the N. G. I.; Major H. J. Redfield. President, National Trade Journals, Inc.: Homer Ferguson, President, Newport News Shipbuilding & Dry Dock Co.; Cav. Luigi Risso, Chief Engineer, and, at the table on the right, Commander Franiesco Tarabotto, Master.*



Graceful sheer lines of the Augustus stand out in sharp contrast to a rugged Mediterrean background.

New York where the parading of the giant liners of the world has satiated the interest in big vessels, AUGUSTUS showed up big. Berthed at one of the modern piers in the Hudson River, her stern extended into the stream, just as the sterns of all the Big Six project beyond the bulkheads when they are berthed. Omit the Big Six, and you will find the biggest vessels in the world are then AUGUSTUS, PARIS and HOMERIC, much of a size. When you think of AUGUSTUS you must think of a really big vessel. She is twice the size of the motorliner GRIPSHOLM which berths at the same pier. She is bigger than the MAURETANIA, and of course, way bigger than any vessel ever built in an American yard.

AUGUSTUS is the pride of Italy, built there and owned there. She belongs to one of the oldest established shipping companies in the world, the Navigazione Generale Italiana of Genoa, a concern so well managed that it has been able to build two such fine vessels as AUGUSTUS and ROMA without a bond issue and without preferred stock. These two ships were built from the same molds, one with Diesel machinery and the other with steam power. The motorship is the faster of the two.

Principal Characteristics of ms. Augustus

Gross register	32,650 tons
Length overall	710 ft. 5 in.
Length b.p.	664 ft. 6 in.
Breadth	82 ft. 6 in.
Depth (to bridge)	97 ft. 9 in.
Draft—maximum	30 ft. 2 in.
Passenger accommodation:—	
1st Class	302
2nd class	504
3rd class	1,404
Total	2,210
Propelling power	28,000 s.hp.
Total power	32,950 b.hp.
Daily fuel consumption (all purposes)	130 tons
Speed at full power	20 knots
Builders	Ansaldo shipyards

Characteristics of Machinery

Number of main engines	4
Power of main engines—125 r.p.m.	28,000 s.hp.
Power of main engines—120 r.p.m.	25,000 s.hp.
Type of main engines	2-cycle d.-a.
Normal operating speed	120 r.p.m.
Cylinders per engine	6
Cylinder diameter (700 m.m.)	27.56 in.
Piston stroke (1,200 m.m.)	47.24 in.
Fuel injection	air blast
Compressors	engine driven
Scavenging	independent blowers

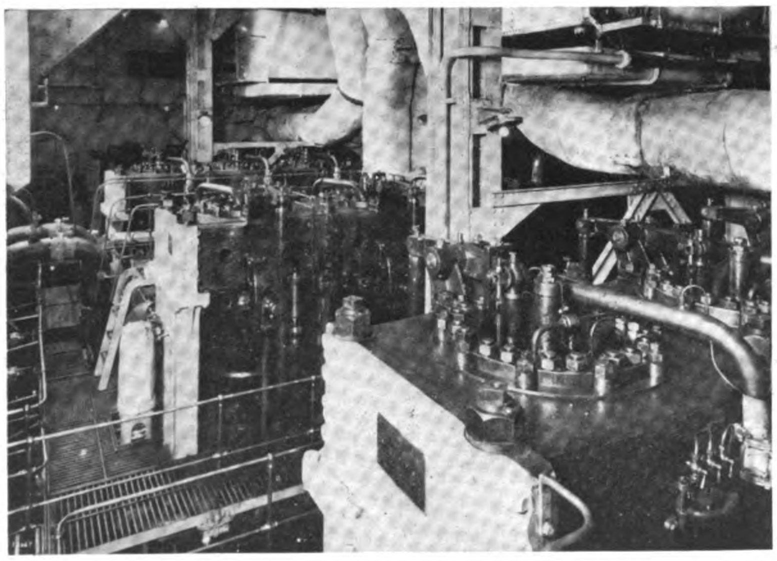
Generator sets:—

Three 900 b.hp., 215 r.p.m., 6-cyl., 600 kw.
Five 450 b.hp., 300 r.p.m., 6-cyl., 280 kw.
Converted to airless injection.

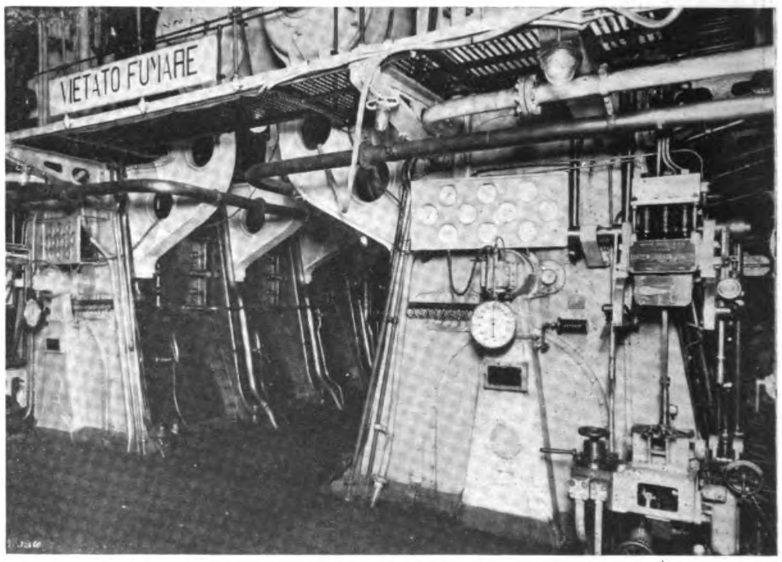
In this summary just given above are all the leading characteristics of ship and machinery. It is on a general review of them and of the experience obtained in their operation that attention will be centered. No detailed description of the vessel will be presented, the reader being referred for technical *minutae* to the European magazines which covered her very fully at the time of her commissioning.

As a quadruple-screw vessel, AUGUSTUS demanded no *tour de force* from the engine builders. With the contract calling for 28,000 shaft horsepower the disposition of power per shaft was only 7000 b.hp., and there are single-screw motor freighters today which exceed that figure. At the time the Navigazione Generale Italiana was sturdying the project for this big vessel in 1924 and 1925, the engine builders were able to demonstrate that the 27½ in. diameter presented no hazard in 2-cycle double-acting engines, a fact of which they were very sure because they had suffered all the grief of its development in a period extending over nearly 15 years. The confidence of the engine builders was built on knowledge. The shipowners had to establish their confidence on the results of investigation into an engineering problem that was new to them. Therefore in emphasizing here that the engine builders were not called upon to accept a risk of things unknown or untried, it is fair to insist with equal emphasize that the Italian shipping company exhibited a discernment and boldness of conviction that deserve the greatest tribute of praise.

Machinery of the M. A. N. type was selected. It was not a mere paper design. It was not even the first or second model of its type. It was the fruition, the suc-



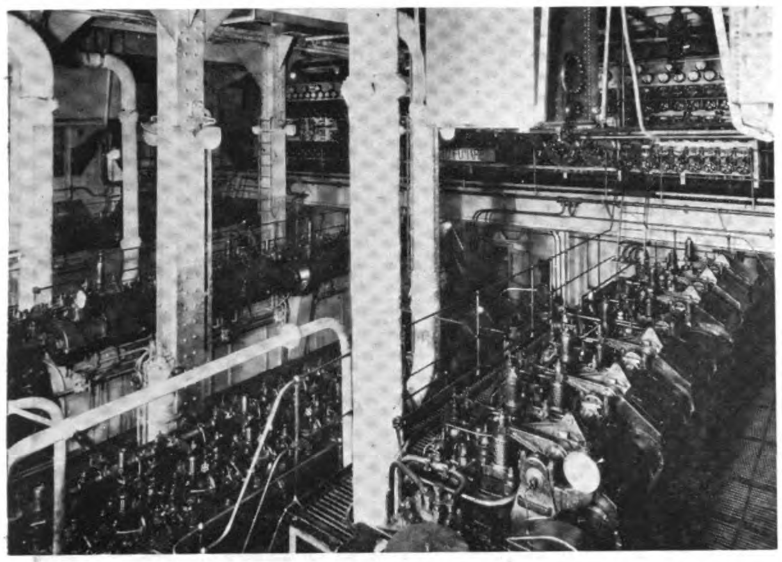
Simplicity of construction marks the upper cylinder heads of the four main propelling Diesels.



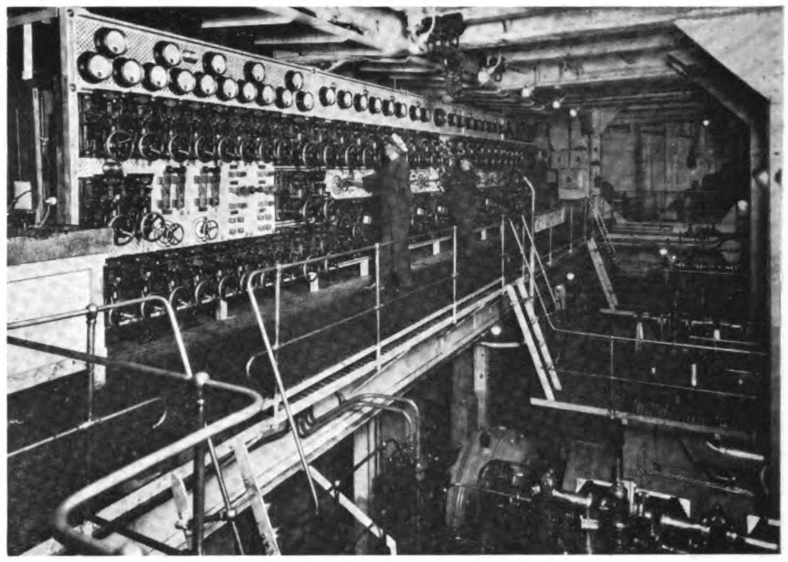
Robust construction is revealed in this view of the two center propelling Diesels of the Augustus.

The Splendor of the Augustus

1, *Sicilian winter garden;* 2, *The chapel;* 3, *Dining room;* 4, *Ball room;* 5, *Lower engine room looking aft between the two center engines;* 6, *Main hall;* 7, *Vestibule and gift shop;* 8, *Open air swimming pool on sports deck;* 9, *Tennis court on sports deck;* 10, *Enclosed veranda;* 11, *Reading and writing room;* 12, *A state room for two.*



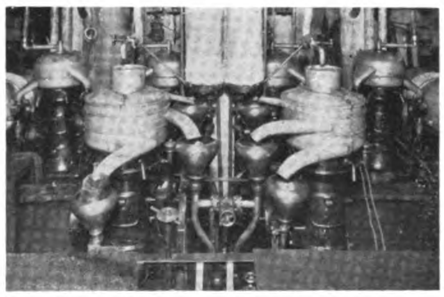
The auxiliary engine room is more spacious than this illustration indicates. It contains eight Diesel-generator sets



Ornate design of the main switchboard lends an appearance of complication not in keeping with its real simplicity.

cess, of years of experimentation and trial and rebuilding (recounted in a very instructive and illuminating article in MOTORSHIP, December, 1923, and January, February, March, 1924). The engineering troubles had all been overcome. A design had been developed which left nothing to be desired mechanically or commercially. And while the attitude of other shipowners towards it ranged from bigoted intolerance to timid patronage the management of the Italian Line stepped forward with forceful assurance and backed it to the limit, that is to say, while one man took it for 4000 hp. they took it for 28,000 hp. And why not? It was the same cylinder size right along the line. The number of cylinders per engine might change, and the revolutions per minute might be altered, but fundamentally all these M. A. N. 2-cycle double-acting engines that have been built in many countries since 1924 are repetitions of a basic 27½ in. x 47¼ in. cylinder design that the Augsburg works had developed with complete success.

The four 6-cylinder engines of AUGUSTUS were built by the Savoia Works in Italy. In their main power lines they are intrinsically the same as the Hooven-Owens-Rentschler and New London engines of 4000 s.hp. in the Shipping Board vessels SEMINOLE and WILSCOX respectively. Same cylinder diameter: same piston stroke: same design of cylinder liner and covers: same fuel pumps and valves: only a little difference in the speed. The engines of AUGUSTUS have six cylinders: the engines of

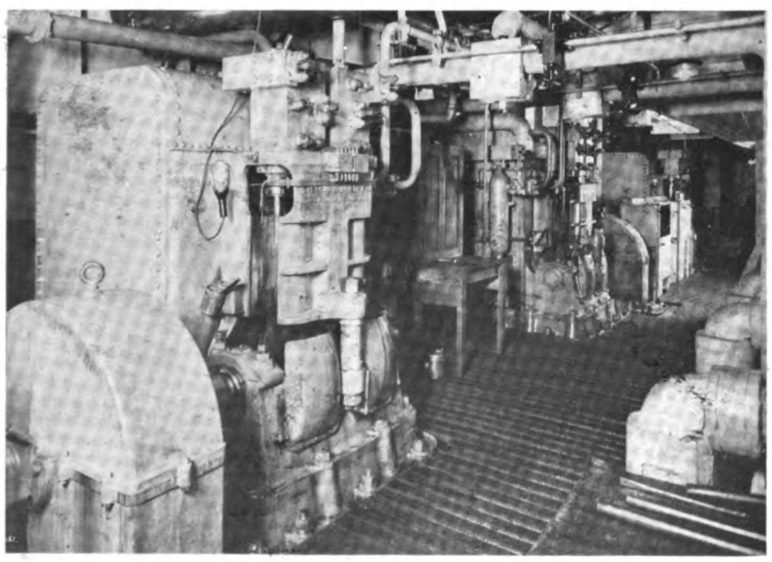


Six De Lavals purify main engine fuel and lubricating oil

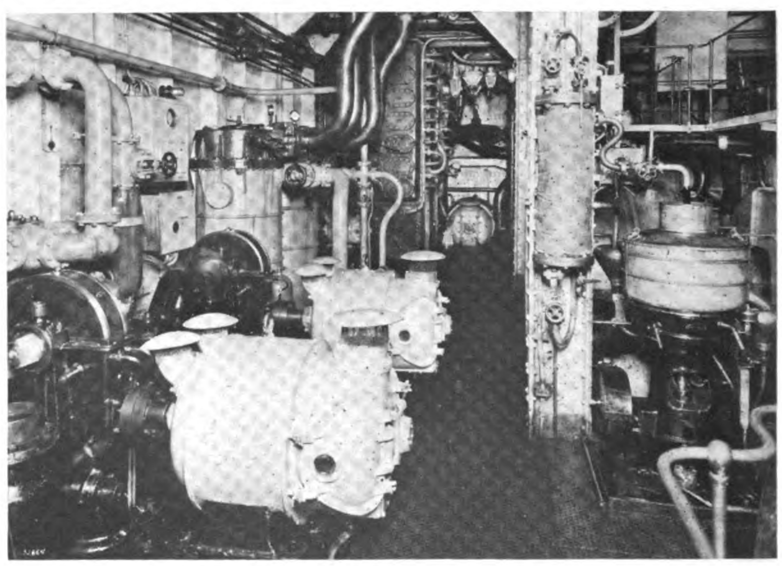
the SEMINOLE and WILSCOX have four cylinders; the former have independent scavenge blowers: the latter have engine driven scavenge pumps—for the rest, all is the same in its broad aspect.

Today, therefore we have two engine builders in the United States who could duplicate the main power plant of the big Italian motorliner, two builders who could furnish similar engines for the MONTICELLO and MOUNT VERNON, and you see now it is no trick at all—since Italy has demonstrated it—to put 28,000 economical shaft horsepower into a 20-knot liner or liners. Only, to turn the trick you must have the will to do it, and that will is compounded of vision, knowledge and strength of mind. The N. G. I. management was just so gifted. Our shipowning and Federal managements are—well, not just so gifted! Nevertheless, she could be built for under ten million dollars in the U. S. A.

All this Diesel power does not shake AUGUSTUS in the least. There is not a tremor from those powerful main engines. That is categorical; there is no equivocation about it. Nor should there be any vibration. Engineers can calculate the incidence of vibration and can contrive to keep the engines free from it in the operating speeds. It is somebody's business to see that the calculations are made, and if in some vessels' machinery no prior analysis was made it was somebody's fault. For the engines of this, the world's largest motorship, the juggling of the vibration was calculated to a nicety. There is no jazzing in the whole range of speed up to the maximum of 125 revolutions per minute, but there would be a lively step a little beyond that speed if the engines could be forced up to it. At normal operating



Electrically driven refrigerating machines are of sturdy construction and use carbonic acid gas.



A convenient arrangement of lubricating oil pumps, coolers and purifiers in the auxiliary engine-room.

power, 25,000 s.hp. and at maximum operating power, 28,000 s.hp., there is not a quiver. The jazz has been set out of range. Similarly, the minor jiggle speed that is inescapable—and is not important—has been sidetracked from the range of "half speed" and therefore never causes any inconvenience and is never noticed. AUGUSTUS is superior to most steamers in this respect and operates as smoothly as a balanced machine on ball bearings.

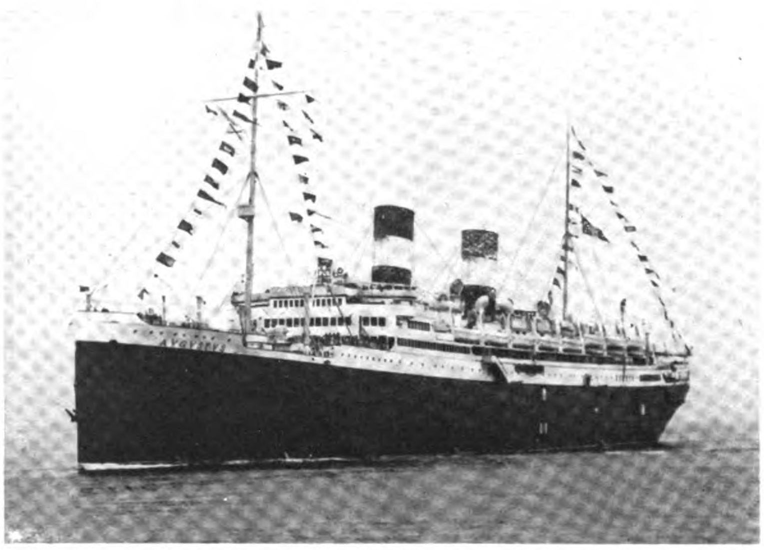
During her shake-down period there was a little machinery trouble, but nothing to worry an engineer. The main engines are still being operated on Diesel oil and it is not yet contemplated to change to a heavier fuel. Under the terms of the contract, the engines had to go through a shop test on full power with boiler fuel, and they went through it successfully. If the prevailing low price of boiler fuel should give any indication of permanence—and that seems less likely now than ever—there would be an incentive to try out boiler fuel for part time operation, with intervals of running on higher grade fuel to keep the engines clean. It is a little early yet to make any trials of that sort.

All the auxiliary engines, however, have already undergone a considerable operating change. They have been converted to airless injection, though the compressors are still hooked up to the engines. In port their fuel valves are all taken out and cleaned, but at sea they are kept continuously in operation just as if they were still operating with air injection. Carbon forms at the valve nozzles, but not excessively and is easily cleaned off. In all probability the airless injection will be permanently retained on the auxiliary engines. Later it may be taken under consideration for the main engines too, on which it would effect a saving of probably some 3000 hp. with a consequent reduction of about 10 tons daily in the fuel consumption, which now averages about 120 tons at sea for all purposes with the vessel making 19 knots plus.

All the machinery space is generously proportioned, and particularly lavish in its roominess is the thwartship starting platform extending across the forward end of the main engines with 15 ft. clearance. There is no impression of crowding, either in the main engine room, auxiliary engine room or steam room, and the lay-out is subdivided in an unusually well reasoned manner. In the main engine room is no more and no less than apertains to the functioning of the propelling machinery. The auxiliary engine room is an electric central station. The steam room contains the boilers for heating and also the service pumps. It detracts little from this methodical layout that the refrigerating machinery and a workshop are installed on a flat in the auxiliary engine room, and maybe there are other minor exceptions. The main rule is evident and it appeals as most excellent practice. Very commendable also is the wide platform both front and back of the main switchboard.

The electric power plant is quite a sizable installation in itself, aggregating over 3000 kw. capacity. All the generators are of the open type, but the ventilation has proved inadequate at continuous full load, and that applies both to the generators and the machinery space. This Fall therefore, the three 600 kw. electric generators are to be enclosed and ventilated through ducts, thus improving both their own ventilation and the ventilation of the auxiliary engine room which they have been overheating. In course of time the other generators may be similarly treated. In fact the best schools of thought predict that the time will come when open-type generators and motors will entirely disappear from shipboard and only fully enclosed electric machinery be seen.

That in brief is how AUGUSTUS shapes up after 9 months of service, a credit to the good judgment of her owners, a credit to the ship-builders and machinery builders and a credit to her officers and crew. Perhaps her building was a big adventure, as indeed it looked to most people—but they did not know anyway. If it was a big adventure it was a glorious one and it had its thrills in the early days of her service.



Augustus entering New York on her maiden voyage to the United States

To-day she stands out as an eminent achievement. She is the ninth largest vessel in the world, the biggest motorship, the most powerful motorship and a success. We who see her today can realize and understand that she was conceived and planned along lines that precluded failure. Those who projected her were gifted with three or four years' accurate foresight.

The more one understands AUGUSTUS the more one must admire the able simplicity of her conception. The architecture of the vessel is admirable and yields nothing to any of the post-war construction, while in some details it is finer. The Diesel engineering is the *optimus* of the modern development, applied in a straight-forward manner. There were no difficulties, except mythical ones. No radically new Diesel engineering has been done, but the Diesel engineering has been done on a larger scale.

The further one delves the clearer becomes the importance of the personal element: the achievement represented in AUGUSTUS is largely the triumph of the personality represented in the management of the Navigazione Generale Italiana. Management of this character will keep any line in the front. It has already lifted the Genoa company to a higher plane in the shipping world. It will carry the N. G. I. to yet greater importance. It is a management of personnel as well as a management of equipment. The staff, ashore and afloat, is keyed up. The spirit of achievement imbues all. If this is the spirit of new Italy, then the Italian lines are going to show the world something more than they have already shown—and that is plenty.

During the turn-round of AUGUSTUS in New York, the U. S. agents of the line courteously enabled MOTORSHIP to invite a number of guests to a dinner aboard and an inspection of the vessel. Invitations were sent to many prominent people in shipping, financial and official circles, and a notable gathering of representatives attended. As Brig.-Gen. A. C. Dalton, vice-president of the U. S. Fleet Corp'n, said, the occasion was memorable because of the goodwill it helped to create between American and Italian shipping interests which is so necessary to the success of the national ship enterprises of the two nations. The guests were received by Captain Angelo Ruspini, managing director of the Italia-America Shipping Corporation, representing the N. G. I. in the United States, assisted by Dr. Santini, assistant director, Comm. Francesco Tarabotto, master of the AUGUSTUS and Cav. Luigi Risso, chief engineer. During the visit the engine room was opened to all the guests, and admiration was generally expressed for the fine machinery installation. Through this hospitality not only was opportunity given for an appreciation of the luxurious comfort of the vessel as well as an understanding of the technical achievements represented in her construction, but the guests were also enabled to become acquainted with the excellent service and snappiness of the ship's personnel, two important factors which seal the success of the ship as a passenger liner.

Impressions of the Augustus' Engine Room

By An Engineer Visitor

WITH sixty other American engineers and their shipowner executives, I was privileged to inspect the great Diesel engines of the AUGUSTUS. My thanks are due MOTORSHIP for being afforded the opportunity. This visit aboard the largest motorship in the world provided a number of very pleasant surprises.

Chief of these was the very obvious fact that the installation was anything but "complicated" or difficult to understand. The main engines are massive, the maneuvering-air tanks have an enormous capacity, the various pumps are really big ones and the engine circulating-water coolers are larger than quite a few so-called rooms in

New York apartment houses. But after all, these things are not hidden away midst a complicated array of mysterious equipment. Any engineer with a fair knowledge of marine Diesel installations can tell at a glance, not only what they are but how they work, even if all the signs are in Italian language.

Running the AUGUSTUS' machinery is no one-man job. There is more power in the auxiliary engine-room than is required by the average 10,000 ton freighter for propulsion. Comprehension of this fact gives the conception that the job is big. On the other hand, the main engines—while impressive—did not seem quite so awe-inspiring as might be expected. Take the Diesel engine of the Shipping Board freighter SEMINOLE, add two cylinders to it, and then install four such engines in a big engine-room and you have the main propelling plant of the AUGUSTUS. This installation is still within powers of comprehension with a man who knows ships.

Yet, in the face of this fact there are many bred-in-the-bone steam-engine men who still appear to mistrust that which they do not understand. Many of them do not understand the Diesel engine. And, they always mistrust any machinery they have not had experience with.

After several hours in the engine-room of this great ship I realized that there is nothing fundamentally difficult about the installation, that it is just as simple, if not more simple, than marine steam equipment of the same power.

Prior to coming aboard the AUGUSTUS I had heard numerous rumors, apparently the effect of a "whispering" campaign, that she has not been operating well, and that she vibrates. Chief Engineer Luigi G. Risso and Captain Francesco Tarabotto both informed me that there is not even a slight vibration of any nature throughout the ship. Slight pulsation I noted in the auxiliary engine-room was from some pumps. There was no vibration whatever from the auxiliary engines in operation.

After her trials it was found that the engine foundation and bedplates had been made too light, but this was satisfactorily remedied. When she was in New York, there was some routine work going on in the engine room; but what well regulated engine room has none? The main engines had not been disturbed and she sailed with them in the same condition in which they were when she arrived. A piston was removed from one of the auxiliary engines; it was surveyed and found to be in excellent condition. So it was put back without so much as renewing a piston ring. The engineers, or oilers more likely, were grinding a few valves and one man was in the workshop cleaning compressor valves. These, by the way, had too much carbon on them. Apparently someone had been a little careless about the way he adjusted the compressor lubrication.

I observed a worth while solicitude for the condition of the lubricating oil, inasmuch as a De Laval centrifuge was in continuous operation, purifying the oil in use in the auxiliaries. No less than six large centrifuges of the same make are similarly employed in connection with the main engines while at sea. With due credit to the auxiliary engines, the centrifuge was not discharging much of a stream at the sludge spout.

My biggest disappointment resulted from lack of an opportunity to explore the innards of one of the big Diesels. This was due to the whole job being in such excellent condition. I returned on the sailing day and found the engine-room crew on the job just like the crew of any other ship, only there was a pronounced absence of sweat cloths.

She was quite cool down below and there were no firemen, either drunk or being carried out on account of fireman's cramps; i.e., bowing at the shrine of Bacchus, standing in front of a red hot furnace and then drinking oceans of ice water, and resting under the cooling zephyrs emanating from an overworked ventilator. What a contrast to sailing days on some of the big steam liners. In years past I have seen the fireroom crew come staggering up the dock, refuse to go aboard and start fighting, then be beaten with blackjacks by the dock guards and forced aboard.

On the AUGUSTUS I failed to locate the First Assistant; the Chief had conducted his guests below. I talked with the boys who wore gold braid on their caps, and, by the way, no uniforms save the usual dungerees and shirts with chopped off sleeves. They were willing enough to answer questions, after a mutually understandable language was found. I learned, among other things, that fresh water is used throughout for cooling the main and auxiliary engines; that the scavenging air for the main engines is supplied with three Brown Boveri blowers located in air trunks built into the after end of the engine-room casing, and that the maneuvering-air tanks carry 425 lbs. pressure.

They volunteered the information that she is a good running job, that they like her and that they are not overworked either at sea or in port. She maneuvers very well, which the Captain confirmed. They seldom have an involuntary stop of any of the engines at sea, and they like New York, even though the best that Mayor Walker could provide in the way of music with welcoming committee on the MACON was the street cleaner's band. The foregoing are just a few of the things I learned. Other things I failed to learn because of lack of knowledge of the Italian language.

Shallow Draft Motortanker for Coastwise and Harbor Service

THE latest member of the fleet of small Diesel coastwise and harbor tankers operating throughout the Atlantic Coast is the M. J. DERBY, recently put in operation by the Sylvestre Oil Co. of New York, who have chartered her for two years from her builders, Ira S. Bushey and Sons, New York.

In working out a suitable design for this type of craft, much care had to be taken in laying out the hull and housing, as she is used to carry fuel from coastwise ports to distributing stations along the Hudson River and Long Island Sound, most of which are on shallow harbors. The vessel has an overall length of 130 ft., a width of 28 ft. and a maximum draft of 9 ft. 6 in. when loaded with 5000 barrels of oil. She is heavily framed throughout and has a wide blunt bow, of sufficient width to accommodate her Diesel-engined cargo pump, an unusual feature on ships of this type. The pump, an eight-inch Northern rotary, is placed on the port side of the bow in a special compartment. The shafting from this runs through a steel partition into another compartment on the starboard side, where it is connected with but separated from a 70 hp. Cummins engine.

The M. J. DERBY is driven by a six-cylinder 360 s.hp. Fairbanks-Morse Diesel engine. A dual set of controls is arranged on a heavy grating over the engine-room. The auxiliary equipment of the new tanker is very complete. A 15 hp. Hill Diesel, is connected at one end by a friction clutch to a three-inch general service pump and at the other to a two stage Ingersoll Rand air compressor. There is a 2½ Kw. 32 volt Universal generating set, which supplies current for driving the De Laval oil centrifuge and the fresh-water pump as well as the regular ship lights. The centrifuge is one of the smallest built by De Laval. In addition, the ship carries a complete Lux-Rich fire fighting equipment and a Prest-O-Lite battery of 220 amps. hours capacity. Over the engine-room is a large deckhouse, with crew's quarters for eight.

M. J. Derby passing the yard of her builders

Ultra-Modern Trawlers for Boston

High Fuel Economy and Greater Carrying Capacity Result From Diesel Power

A NUMBER of interesting constructional details are found in the three trawlers building at the Fore River Plant, Quincy, Mass., of the Bethlehem Shipbuilding Company. All three vessels will have the same general dimensions. Two of them are for the Massachusetts Trawling Company and will be identical, the third, for the R. O'Brien Company, also of Boston, will embody some minor differences. The principal dimensions are, length 123 ft., beam 23 ft., and depth 13 ft. 3 in. and 12 ft. 6 in.

The maximum draft will be approximately 10 ft. 6 in. and excess capacity is provided for 200,000 pounds of fish with approximately 35 tons of ice. The fish holds are 36 ft. from steel bulkhead to steel bulkhead, giving a large space for trawlers of this size. This saving in space may be credited to Diesel power, and since the earning capacity of a trawler is proportionate to the capacity for carrying fish, the advantages of Diesel power are not confined to fuel economy alone.

The main propelling unit for all three vessels consists of a four-cylinder 380-hp. two-cycle solid injection Bethlehem Diesel engine. In the two vessels for the Massachusetts Trawling Co., this engine drives a generator on the main line shafting which is connected through a Cutler Hammer magnetic clutch to the propeller. By this arrangement, abundant power for operating the trawl is obtained direct from the main propelling unit without an additional Diesel generating set. This is an innovation in the fisheries, although used with success in other commercial craft. Its adaptation to trawling will without doubt be of great interest to other operators, for by eliminating an engine it means a considerable saving in initial outlay and running expense.

The auxiliary Diesel generating set is, of course, the conventional arrangement for driving the trawl winch and this arrangement has been adhered to in the design for the R. O'Brien Company. Their vessel is being fitted out with a 90-hp. Bethlehem Diesel generating set. The trawl winch is of special design developed by the Bethlehem Shipbuilding Corporation, as is also the steering gear. All three vessels are equipped with motor driven auxiliary fire, bilge and general service pumps, also an air compressor and a 10 k.w. auxiliary Diesel generating set to take care of stand-by loads. A worm gear motor-driven fish hoist is provided at the base of the foremoast for operating the fish whips on the gaffs of the foremast.

THE employment of these great fishing craft cause one to speculate on the future of deep-sea, or offshore, fishing. By the way things are developing, we believe, that before many years pass, we shall see trawlers of 1,500 tons engaged in the fresh fish industry. They will be driven by Diesel engines and chock-full of labor-saving and waste-saving machinery. Their crews will be skilled mechanics under the command of a scientifically trained fisheries engineer. The fishing master will catch the fish only.

—Fishing Gazette.

Fuel oil is carried forward of the fish hold and aft in the engine room. This distribution of fuel gives the control of trim so necessary and desirable in these vessels.

Each trawler is fitted with a small vertical tubular steam boiler capable of supplying steam not only for heating quarters but also for the cooking of fish livers.

The general layout shows that care has been taken to make the ships "livable." Comfortable accommodations are provided in the forecastle for fourteen men, while the engineers, officers and cook are provided with staterooms on the lower deck aft of the engine room. The captain will have a separate cabin immediately aft of the pilot house. The galley perhaps the most important single factor in the comfort of the crew, is of ample size, well ventilated, and located at the after end of the deck house, which appears to be the ideal location in a boat of this type.

In general, the vessels are strongly constructed with scantlings, based on North Sea trawlers which have definitely proven their merit for this service, and the performance of these Dieselized trawlers, embodying progressive ideas, will be watched with considerable interest, as representing a definite step forward for the fishing industry of New England.

Operation of U. S. Goast Guard Diesel Boats

In the August issue of MOTORSHIP we published an article on the operation of the Diesel boats for the U. S. Coast Guard. A table was given of the average operating cost, which was taken from an official blueprint supplied to MOTORSHIP known as "Performance and Engineering Expense Sheet" July 1, 1926-June 30, 1927. We have been advised, however, that the 125 ft. Winton Diesel engined patrol boats were not carried on that sheet for the entire year. This accounts for the reason that their operating cost seemed to average higher than they actually were, and that the distance covered was much less than actually made.

We have been furnished with the following figures based on the operation of the 125 ft. Squadron 2, during the last fiscal 12-month period:

Miles Cruised	21,790.18
Fuel oil cost	$1,632.47
Lubricating oil cost	260.08
Kerosene, coal and water	580.11
Repairs, deck and engine room	433.84
Supplies, deck and engine room	1,145.80
Average cost per mile (Includes all expenses except pay of personnel)	.18½
Gallons of fuel oil per mile	1.53

We are glad to give publicity to these figures which do more justice to the economical operation of Diesel engines.

General arrangement plan of one of the Boston trawlers building at Quincy, Mass. Insert, launching the first boat

Foreshadowing High-speed Diesel Yachts

Light Weight, Sturdy Construction and Dependable Engine Performance Are Essential

SO whole-heartedly have American yachtsmen taken to Diesel powered yachts that there are now over 150 of American registry in operation or under construction. The estimated power of these vessels exceeds 79,000 b.hp. of which 75,140 b.hp. is accurately accounted for in 121 vessels registered with Lloyd's. The remaining 23 yachts are comparatively small and the exact power has not been registered, but conservatively estimated amounts more than 4000 aggregate b.hp. Thus far only moderately high speed has been attained in Diesel yachts. But, a desire has been expressed among certain yachtsmen for comparatively large vessels capable of travelling at express speed, and Diesel engine manufacturers are rising to the occasion admirably.

A visit to any American yacht club, or for that matter a trip to the "bone yard" will reveal a tendency among big men of affairs to become temporarily little boys at play. There is nothing surprising, unusual or disgraceful about it. A boy can still teach a grown person many ways to play.

Yachting is a wholesome sport, worthy of the best of us. Nevertheless it is doubtful if a million dollar yacht can give its owner the same joy of ownership, the same feeling of pride in achievement that he must have felt, if once he built and owned, as we have, a raft of wood with a burlap sail that we steered with a board and imagined to be a battleship, privateer or a Chinese junk. At the yacht club can be found in actual fact what was seen in imagination in the rafts built when boys; an imitation clipper ship, a small ocean greyhound, a perfect fishing smack (without the smell of one), a lumber schooner, a submarine chaser or perhaps a little battle cruiser. Some of them appear to hail from the land of make-believe; but there is no make-believe about the quarters, the Diesel engines, the sturdy hulls or the ability of the crew.

No expense is spared in the construction of these splendid craft for the best is none too good for the man seeking pleasure. It is man's inalienable right to amuse himself as he will, and so it would not be surprising to discover a true replicas in external appearance of the HALF MOON, the MAYFLOWER or the SANTA MARIA fitted out with electric light, radio, automatic steering and a Diesel tucked away in the stern, just for safety sake. But hailing from this land of make-believe a more probable development would be a small airplane carrier, capable of the speed of a LEXINGTON or SARATOGA, with a catapult or perhaps a landing deck and planes in place of motor launches for the tendency in play is to imitate the big, the modern, the spectacular events of modern times. Attainment of speed is outstanding in the present so-called "machinery age" and so we may expect to find it expressed in play.

Unlike the boy at play the yachtsman is consistently logical in many ways. Lessons in economics, learned in the great school of worldly affairs are not easily forgotten. In pursuing his fascinating pastime he makes a number of important discoveries. His Diesel engine is actually a thing superior. It has made his vessel cleaner, quieter, more nearly vibrationless and is less costly to operate than steam, so he accepts it as being essential to his comfort. He realizes that he can no more dispense with it than he can dispense with electricity, heated quarters, music, the radio and his motor launches.

If the sportsman could be satisfied with the ordinary things of life he would be a very poor sportsman indeed. The world continues complacently to revolve at a uniform rate of speed but infinitesimal objects upon its surface have taken a new lease on life and move more and more rapidly. This scurrying hither and yon is essential to commerce and civilization. What may be done commercially may be excelled in sport. The very essence of sport is to excel in speed, in strength, in stamina and in endurance under trying circumstances.

Since the Diesel has been found equal to all other marine power requirements it is not at all surprising that the yachtsman may ask why the Diesel yacht can not be made to surpass all other yacht types in speed. It is true and is being proved, that the Diesel can be employed to fill this requirement of speed, so money will be forthcoming to pay for it.

But speed is not the only item necessary to the yachtsman. He insists that it be speed of quality. It must not include noise, vibration, dirt, or any other form of annoyance. Were this not so it is possible that high speed, high power, light weight gas engines, with their attendant smell, short life and danger, not to mention an almost insatiable thirst for fuel would entirely fill the bill. In fact, up to a certain size, they have been used for this purpose, and found wanting in many essentials, not the least important of which was power, which limited the size of fast yachts.

With new developments in the high-speed Diesel field, following one upon the other, not in small power alone but with engines already of as much as 3000 s.hp. large high-speed Diesel yachts are an assured success and are being built. If the big boys at play now decide that they want a small LEXINGTON or SARATOGA little remains in the way of it. And since it is possible it is quite probable for after all there is a fascination in rapid travel which appeals to every red-blooded person on earth. If speed is the thing which is going to give the yachtsman the most pleasure, why shouldn't he have it? Money so spent will be an incentive to further engineering progress.

Light Weight Diesel for Express Yachts

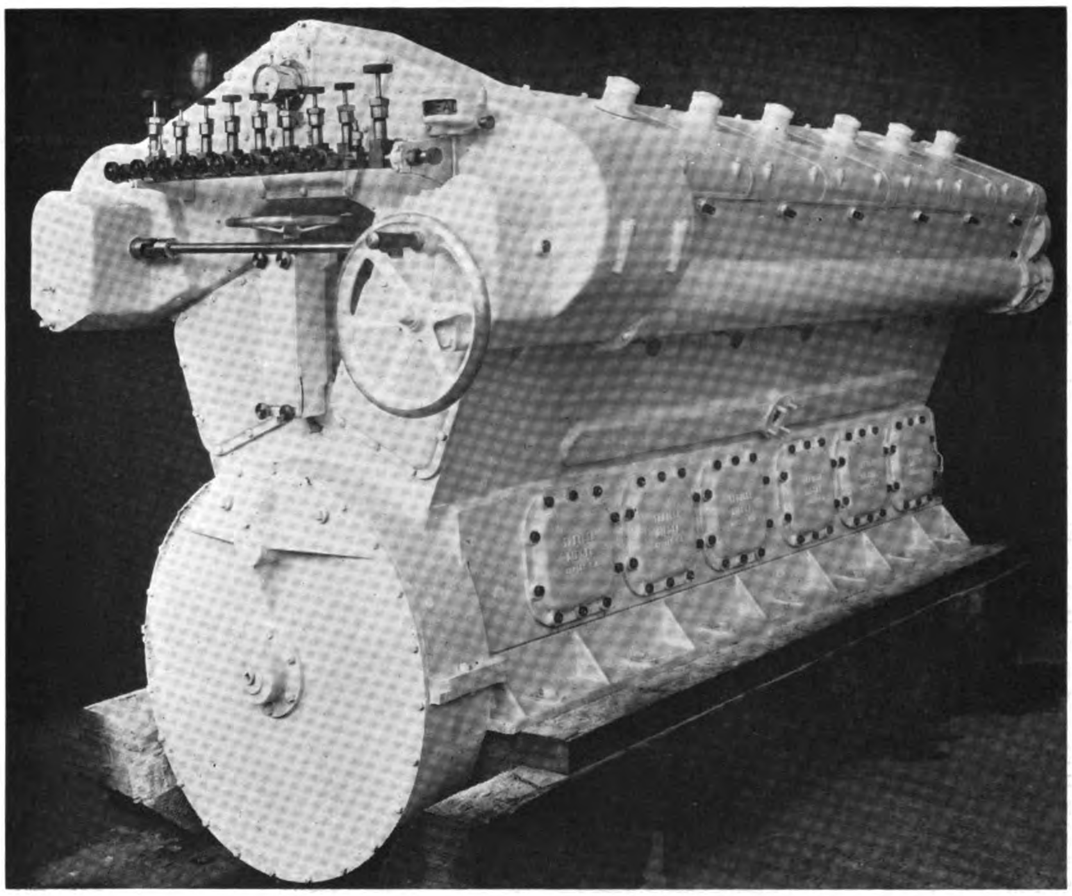
Special Materials and V-type of Construction Give Minimum Weight to Marine Diesel

THE heart of a yacht is found in the engine-room in the form of a Diesel. It must be sufficiently rugged to withstand the continuous operation demanded of it. Nothing can be sacrificed on the altar of speed that may lower the bars to danger afloat. In the construction of such engines for marine propulsive purposes a substantial guarantee must be made of a reasonable continuity of service.

Twin light weight Diesels calculated to meet such requirements recently have been completed by the Treiber Diesel Engine Corporation, Camden N. J., for a yacht now building at the Herrshoff Manufacturing Co. for H. F. Vanderbilt. The vessel will be 150 ft. in length, 24 ft. beam and 6½ ft. draft. These engines are perhaps the lightest weight Diesel built thus far in a commercial way. They are V-type with twelve cylinders and develop 750 hp. continuously at 700 r.p.m.

Their light weight is made possible by utilizing extensive experience gathered by the engineers now with the Treiber Diesel Engine Corporation. During the past fifteen years—we are advised—these men have been responsible for the designing and building of thirty-five different sizes and types of Diesel engines from which hundreds of engines have been built. Each new design has resulted in some additional knowledge which could be utilized in the next model. And so the weight has been reduced from 175 lbs. to less than 25 lbs. per horsepower. Hence a comparatively small vessel may be heavily powered.

During recent years there has been considerable progress made in metallurgy and



The new Treiber Diesel is completely enclosed making it a clean engine and a quiet one

this has contributed in reducing Diesel weight without impairing reliability and long life. The new model just completed weighs 17,500 lbs. According to the manufacturer the engines delivered their rated 750 s.hp. continuous load at 700 r.p.m. for thirty-six hours. They operated an additional two hours at 830 s.hp. and they pulled 950 s.hp. for short periods.

Metals entering into their construction have been selected with a view to giving maximum service irrespective of cost. A single piece solid forged, hollow-bored and carefully balanced crankshaft is bedded in bearings in the base casting which is extended to enclose the flywheel and jacking gear. Unlike the flywheels of slower turning engines these are not made of cast iron, cast steel being used instead, to eliminate the possibility of them going to pieces and causing severe damage.

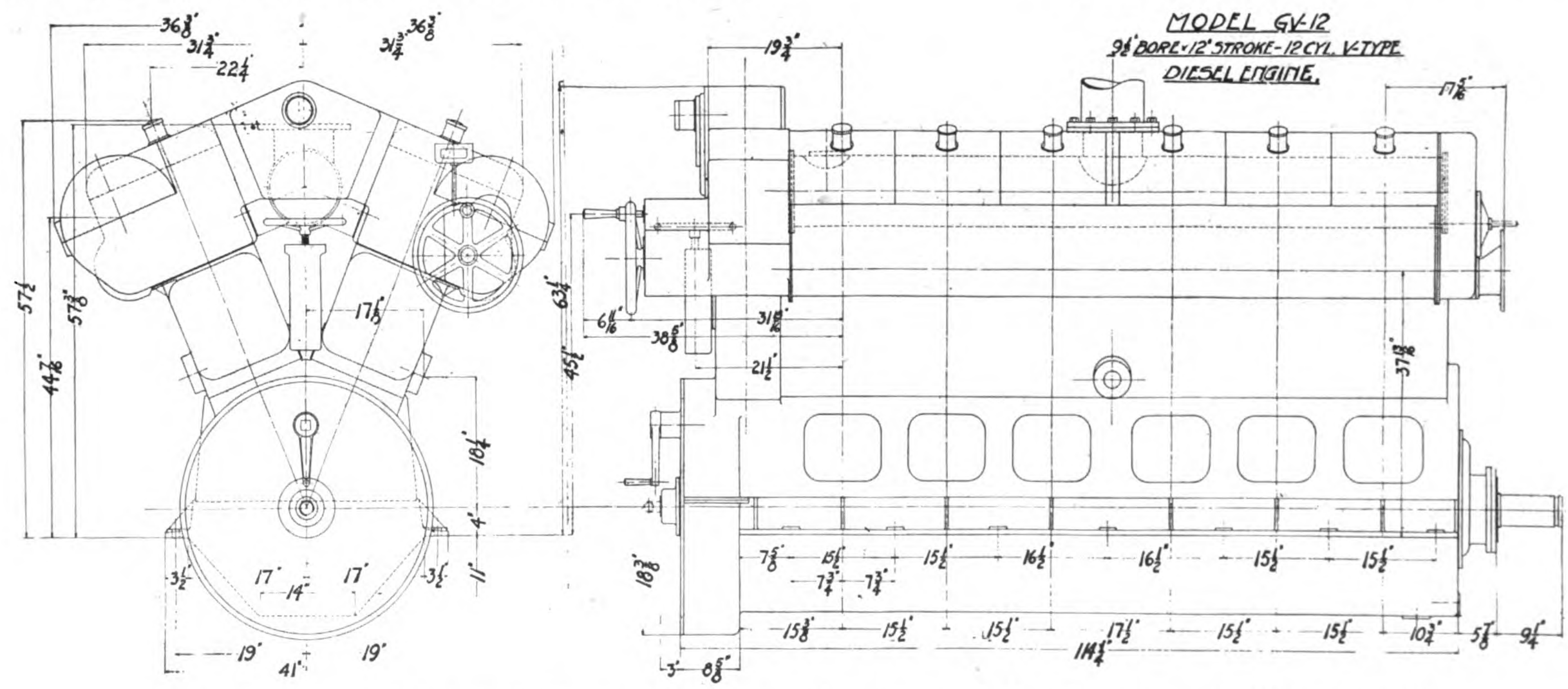
An example of the carefully worked out design, which gives these engines their solid-block appearance is found in the thrust bearing, made of a one-piece forging and mounted in a housing integral with the engine. The crankshaft bearing shells are made of forged steel lined with special babbitt centrifugally cast and bonded to the shell so as to eliminate the need of anchor grooves. Bu-nite pistons of a nickel-aluminum alloy, are fitted with Double-Seal piston rings and oil scraper rings and the connecting rods are made of heat treated chrome vanadium steel. Calculated to reduce deterioration resulting from rust and electrolysis, all parts coming in contact with salt water are made of ferrous metal which has about two and one-half times the strength of cast iron. This includes the water jackets, cylinder liners and cylinder heads.

The enclosed feature of these engines coupled with the many improved details of design result in quiet operation. By carefully balancing all reciprocating parts vibration has been eliminated, according to the manufacturer.

Maneuvering is accomplished with ease. A telltale is built into the engine with the position of the maneuvering mechanism always showing in front of the operator. Thus he knows whether the engine is set for going ahead, going astern, or stopping.

Other sizes of light weight Diesels are built by the Treiber Diesel Engine Corporation. Among them is the twelve cylinder V-type 3000 hp. engine described in June MOTORSHIP, also a six cylinder in-line 300 hp. engine. Production of these light weight engines is their manufacturer's reply to a desire often expressed among yacht owners for increased speed resulting from the use of Diesel engines.

It is apparent, however, that demonstrated success of these engines, following their installation and operation, will lead to their wider application in the power field. This may not be confined to marine service alone. The next logical application appears to be railroad service. The Diesel engine is bound to play an increasingly important part in all phases of transportation. This has already been extended to aerial navigation, and although the Treiber Diesel as yet is too heavy for such service, its light weight marks an important step forward in the direction of modern transportation. We are on the threshold of another new era.



Principal dimensions of the 750 hp. V type 12-cylinder are given above and show the space required for installation

Achievement in Light Weight and Quality

Prominent Yacht and Yacht Machinery Builders Produce a Diesel of Advanced Design

PROGRESS in the development of Diesel engines has resulted in the building of a large number of different models and types, many of which are intended to meet specific requirements. Engineers responsible for an engine of new design often find it necessary to devote considerable time to a study of the conditions under which the engine will operate. The Consolidated Shipbuilding Corporation, Morris Heights, New York, have produced a new light weight Diesel to meet the requirements of moderate sized yacht propulsion. They have to their credit an enviable engineering record, of forty years standing, in the construction of high class yacht machinery, both steam and gasoline. It is apparent, therefore, that they have undertaken this project with a complete understanding of conditions of operation which their new engine will be called upon to meet in service.

The first engine, now completed and ready for installation, is a striking example of what can be accomplished by the combined efforts of engineers well versed in their undertaking. It has undergone extensive shop tests calculated to equal, or be more severe than actual service conditions, and satisfactory results have been obtained. It starts, maneuvers, and reverses as quickly as the control lever can be moved. It operates quietly and smoothly at speeds of 1000 r.p.m. and less. The best fuel economy thus far attained has been .40 lbs. of fuel per b.hp. hour.

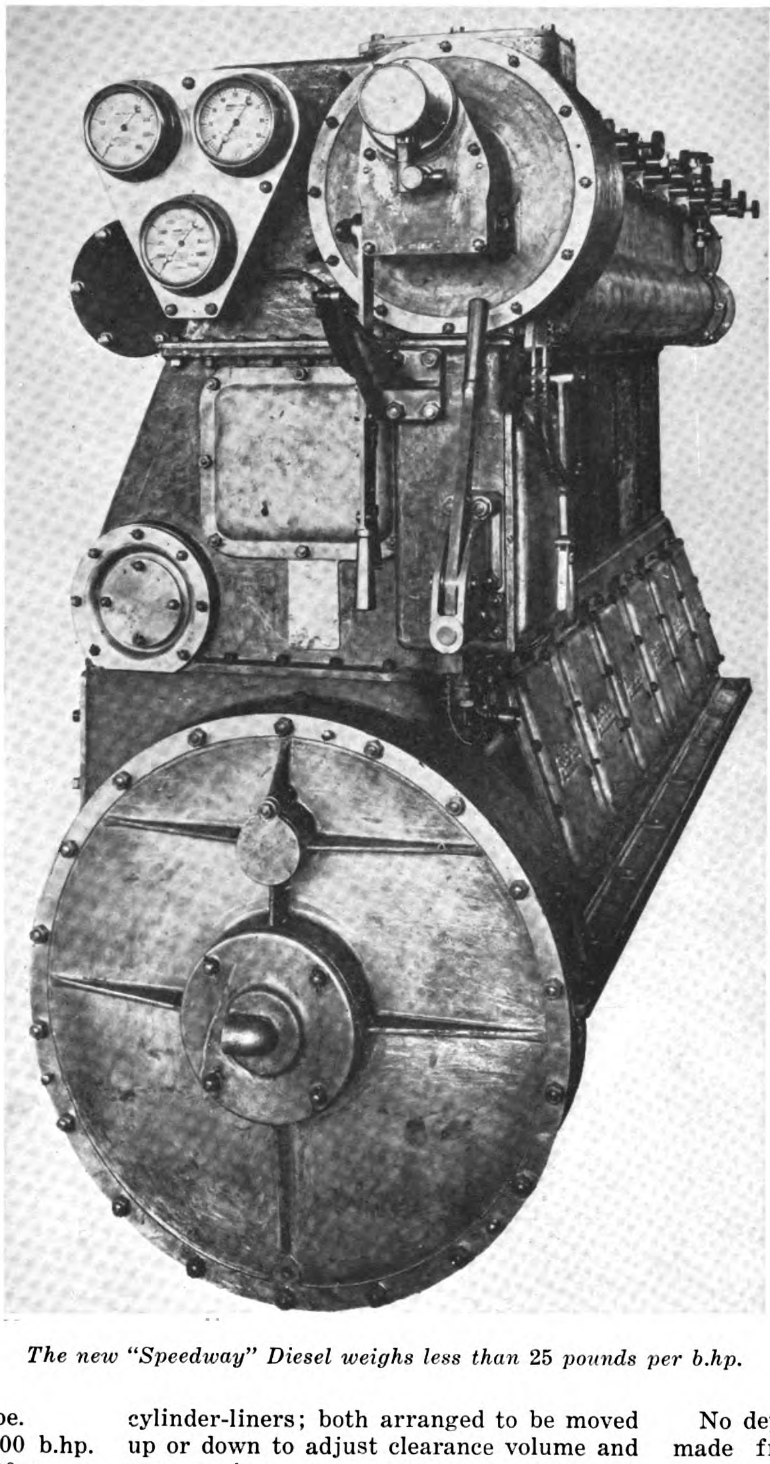
A sharp departure from hitherto conventional practice has been the complete elimination of cast iron. The frame is made of aluminum except where salt water is circulated. The cylinder-heads, cylinder - liners and water jackets, are a special ferrous metal, of the strength of cast steel and impervious to the action of sea water.

Principal Characteristics

Four-cycle, six-cylinder, trunk-piston direct reversing type.

Power	300 b.hp.
Speed	700 r.p.m.
Bore	8½ in.
Stroke	11 in.
Weight complete with pumps, oil cooler and mainfolds	7,600 lbs.
Length of base including flywheel casing	90¾ in.
Height above C-L of crankshaft	53 in.
Height above bottom of base	65 in.

A rigid assembly is attained by the use of one-piece base, centerframe and water box castings tied together with high tensile alloy-steel tie rods, which pass from the base to the top of the cylinder heads and absorb all vertical stresses. The water box supports the cylinder-heads and removable



The new "Speedway" Diesel weighs less than 25 pounds per b.hp.

cylinder-liners; both arranged to be moved up or down to adjust clearance volume and compression.

Calculated to reduce inertia forces to a minimum Bu-Nite (aluminum alloy) pistons and light, drop forged connecting rods, made of Vanadium steel, are employed. The pistons are fitted with two-piece Double-seal piston rings. The connecting rod crank bearings, like the main bearings, are fitted with forged steel shells, lined with Post Motor-marine bearing metal, centrifugally poured and securely bonded to the shells. Actual in-service experience with this particular babbit has convinced the writer of its worth. Credit should be given where credit is earned. Some years ago the writer found that this metal has unusually excellent qualities. Two engine of the same make and power were installed in sister ships. Post Motor-marine metal was used in one, and a metal of unknown origin in the other. At the end of one year of operation the unknown metal was so badly broken up that a number of bearings had to be renewed. The other engine has been in service for five years, and to the writer's knowledge the metal is still in excellent condition.

Conventional pressure lubrication of the main bearing and crank is used. The crankshaft is hollow-bored and lubricating oil pumped into the forward end of it passes through to outlets at each bearing. A safety valve at the after end of the crankshaft by-passes surplus oil to the base. The oil is then pumped from the base to a filter and supply tank by means of one of two rotary type Gould lubricating oil pumps. The second pump maintains the correct pressure of filtered oil from the supply tank, on the lubricating system.

The camshaft is mounted overhead and driven by means of a silent-chain, which also drives the pumps for water circulation, lubricating oil and fuel transfer. Slack in the silent-chain is taken up by means of a tightener, thus ensuring continuity of correct value timing for ahead and astern running. Since the engine is reversible a double set of cams are employed. Stopping and reversing is accomplished by shifting the camshaft longitudinally. At mid position of the reversing lever the valves cannot function and so power ceases automatically with the act of reversing. Injection of fuel ceases when the reversing lever is placed on mid position.

No departure in basic principle has been made from an already established and proven airless injection method. The fuel pumps receive fuel from a service tank and maintain a high pressure on a common line with branches leading to each of the six fuel valves. Isolating valves are fitted so that the fuel to any cylinder may be stopped without interfering with operation of the others. The amount of fuel injected is governed by the amount

of lift of the mechanically operated fuel valves and the pressure on the line. Equal distribution of the load throughout the various cylinders is accomplished by varying the lift of the fuel valve needles. This may be done while the engine is in operation. Control of fuel injection pressure is accomplished by means of a spring loaded relief valve in the fuel pump delivery line. By moving the speed control lever the tension on this spring is changed and a corresponding change in injection pressure occurs.

By moving the reversing lever to mid position all valve actuating rocker arms, including the injection valves, are thrown out of contact with the cams. In this position the fuel valves cannot open, no fuel can be injected and combustion cannot occur. This single lever arrangement for stopping and reversing is equivalent to an interlock. A foot-lever admits air for starting and a separate lever is employed for acceleration.

Lubricating oil, fuel oil and water pressures, and the speed of the engine, are indicated with three gages and a tachometer mounted on an attractive gage board on the front of the engine, near the control levers. Exhaust gas temperature of the different cylinders is indicated by means of Brown pyrometers.

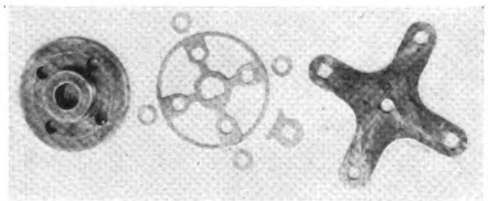
Either one of two types of thrust bearings are optional. One is of the flat roller double self-aligning full floating type and the other is a Kingsbury. The thrust bearing is located within the engine and is lubricated by the pressure system used on all bearings.

This engine has been developed to fit a general scheme of yacht construction successfully employed for many years by the Consolidated Shipbuilding Corporation. They have inaugurated a policy of undivided responsibility. Their yachts are a complete consolidated product, including machinery. They have put forth every effort to make this engine successful because their reputation not only as engine builders, but as yacht designers and builders would suffer directly if the engine fails to meet their own standards of high quality. Having produced an engine to meet their own exacting requirements, they feel that it will also meet with popular approval amongst yacht owners in general. This is no doubt true, and it seems probable that the engine eventually will be put to many different uses where light weight and high speed is required.

Importance of Good Oil Filtering

New Type Oil or Water Filter Applicable To Wide Variety of Marine Diesel Duties

To be effective a filtering device must be efficient then clean, and must meet with the approval of the operating personnel. It must be capable of performing the allotted task, without imposing an undue amount of work upon the men who operate it. It must be easily cleaned to ensure proper attention by the operators. Operating engineers and officials recognize that equipment requiring excessive attention to maintain it at the highest point of efficiency frequently suffers through neglect. Should a filtering unit find itself included in the category of troublesome devices, its efficiency will be lowered. Consequently the machinery it is intended to protect indirectly suffers. Hence, in the final analysis, appeal to the operator often becomes a deciding factor governing its more or less universal acceptance and efficiency. This is not because the operator's word is weighty, but because his methods are decisive.

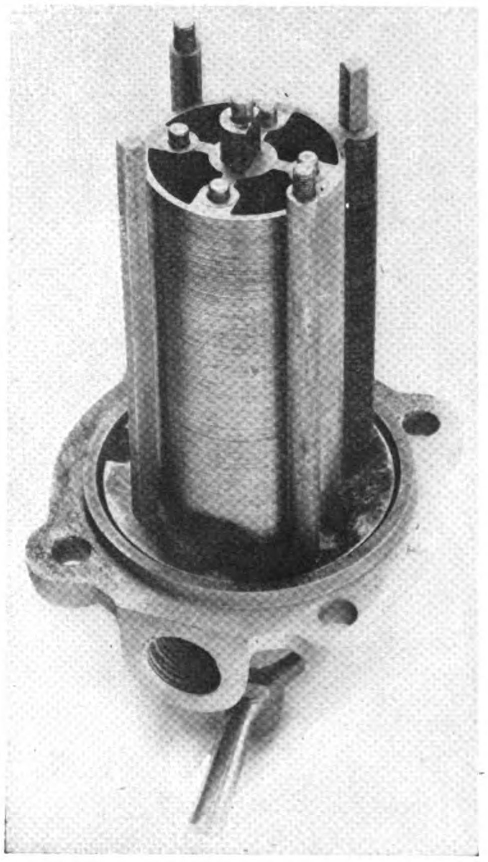


Parts of the filter assembly

The "Auto Klean" filter, manufactured by the Cuno Engineering Company, is of especial interest to American Diesel and marine engineers inasmuch as it represents an established English design adapted to American operating and production requirements.

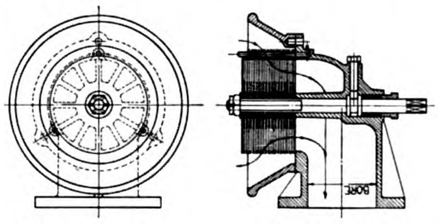
In the form in which it has been produced overseas, the filter in question has been standardized. It has been specified by the British Admiralty, and is widely used on the motorships: ASTURIAS, BERMUDA, CARNARVON CASTLE, and a large number of Diesel-powered freighters, tankers, workboats, and yachts.

The need of removing foreign substances that too frequently become entrained in oil, fuel and water used in the Diesel engines, is too well known to bear lengthy discussion. That some filtering devices too frequently fail is evidenced by the repeated attempts to improve them. Thus far no attempt has been made to change the basic principle of filtration. In our present state of enlightenment, this may be taken as evidence that there is nothing wrong with the principle. It involves the use of an element with orifices so fine as to check the passage of the very finest particle of solid matter entrained in the liquid. At the same time the liquid is permitted to pass. If the orifices were smaller than the finest particles of solid matter, the filtering element would soon become completely clogged. The clogging would result when the number of particles equal the number of orifices.



The "Auto Kleen" filter with outer casing removed

With this thought in mind let us consider the "Auto Klean" filter. Its filter element, which can be used with fuel oil, lubricating oil, or water systems, consists of a hollow cylinder made up of a large number of thin metal disks. The space between the disks is small enough to give the necessary straining effect as the fluid passes through to the interior of the cylinder.



Mounted as a sea suction strainer

As shown in the accompanying illustration, the space between the disks is determined by the thickness of a small spacing washer, which is usually about .0024 inch thick, depending on the degree of filtration required.

Very thorough filtration is obtained. Not only because of the very small space between the disks, but also because the microscopic burr, left on the metal when the disks are stamped, offers an additional bar to very fine particles of suspended matter.

In comparison with the actual size of the inlet and outlet connections, a very large filter area is obtained, as the combined area of the slots between the disks

is usually about five times the area of the pipe connection of the filtering casing. This arrangement lowers the restriction of the filter element to a minimum, and also slows up the velocity with which the fluid must pass through the filter element. Thus its filtration efficiency is increased.

The most outstanding feature of the unit, however, is the cleaning device, which allows the element to be cleaned without interrupting the flow, avoiding the necessity for "duplex" valves and similar arrangements.

A thin tongue of metal is supported on a rod adjacent to the filter space between each disk in the cylinder. When the cylinder is turned on its own axis, these tongues act as scrapers and remove any particles of dirt which may have accumulated on the outside of the cylinder.

The dirt thus removed, falls into a sump in the bottom of the filter casing from which it can be periodically removed, when the liquid is not flowing. In the larger units, the dirt can be taken out through a gate valve while the filter is operating.

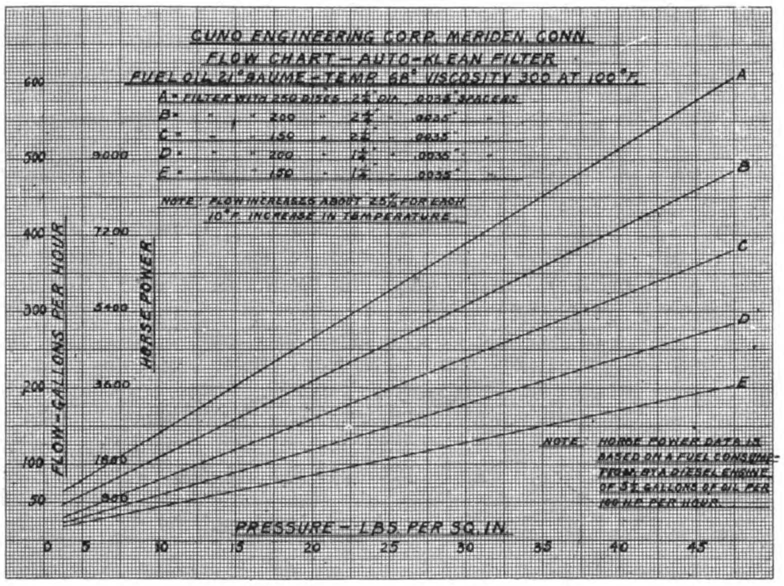


Chart showing low resistance to oil flow.

These filters are supplied in a number of sizes and mountings suitable for virtually any type of marine Diesel engine and for general marine filtration service. One of the accompanying views is of a standard filter unit for use on Diesel engine fuel or lubricating oil supply. The outer casing is shown removed. A sectional view is also shown of a filter mounted for use as a sea suction strainer—a type of installation which has been made on a number of motor-vessels.

The design of sea suction strainers has not changed greatly over the last few years. On motorships it has followed conservative steamship practice and obstructions are cleared away with a jet of steam or compressed air. Both are fairly effective, but the mechanical method just described is more effective.

Diesel Pilot Boat for the Delaware

THE Diesel powered pilot boat now under construction at the W. G. Abbott shipyard at Milford, Delaware, is nearing completion. She was designed by Howard E. Cornell for the Pilots Association for the Bay and River Delaware and is to be powered with a 360 H.P. Bethlehem Diesel. Electric auxiliaries will be used throughout, power being supplied by a 15 K.W. Cummins Diesel and Westinghouse generating set supplying current to the following auxiliaries:

Name of Auxiliary	Power	Make
1 Windlass	6½ h.p.	American Engineering Co.
1 Boat Hoist	7½ h.p.	American Engineering Co.
1 General Service Pump	5 h.p.	Fairbanks Morse
2 Fresh and Salt Water Sanitary Pumps	½ h.p.	Le Courtney
1 Auxiliary Air Compressor	7½ h.p.	Gardner
1 Fuel Oil Transfer Pump	1½ h.p.	Viking
Storage Batteries	110 volt	Edison

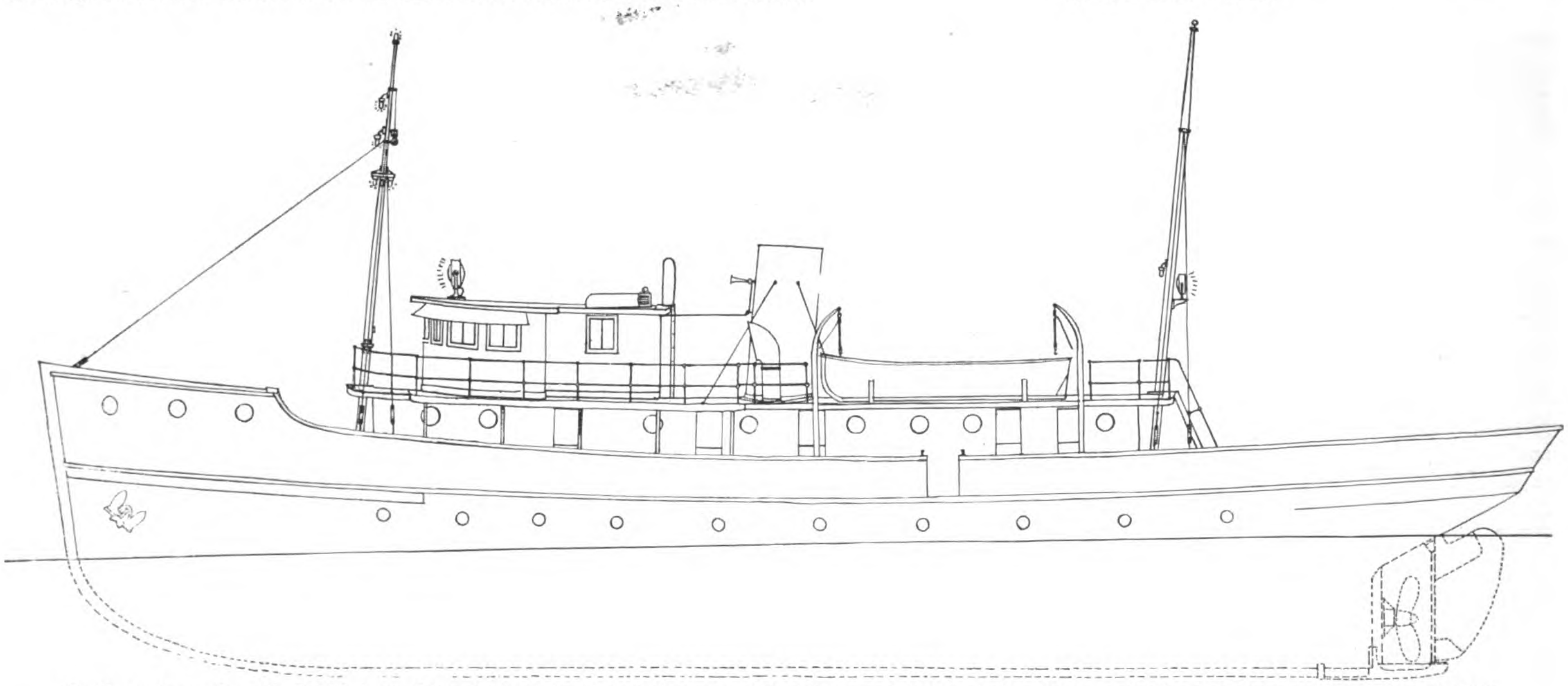
Lighting throughout is by electricity, current being supplied by the generator and the storage batteries. The latter have sufficient power to operate all of the auxiliaries for a limited period.

The principal dimensions of the boat are length o.a. 119 ft., beam 25 ft. and moulded depth 13 ft. She is being built of yellow pine and white oak; the stem, stern post, horn timbers, keel, outside planking, deadwoods, frames, rails and all plank sheers are of white oak, and the keelsons, ceiling, shelf, clamps, deck beams, deck, and waist are of yellow pine. Berthing accommodation is being provided for sixteen pilots and a crew of thirteen men. It is expected that the vessel will go into commission at the end of this year.

Hand steering gear of the geared type, furnished by the American Engineering Company, will be installed. The usual Pilot signals, floodlights and search lights of 1,000 watt capacity will be furnished. Electric refrigeration furnished by the General Electric Company will be provided, and the Pilots' Quarters will be ventilated by a motor driven exhaust fan. The vessel will be heated throughout by steam.

Fuel oil tanks having a capacity of 11,000 gallons are installed in four units. It is estimated that this is sufficient to operate the vessel for a period of three months without re-fueling.

Two life boats of the Association's type are swung under davits and are handled by the boat winch.


Outboard profile of Bethlehem Diesel pilot boat building for Pilots' Association of the Bay and River Delaware at Milford, Del.

New Small Diesel Has Advanced Fuel System

Clean Combustion at Full Power and High Fuel Economy Characterize the New Hill Diesel

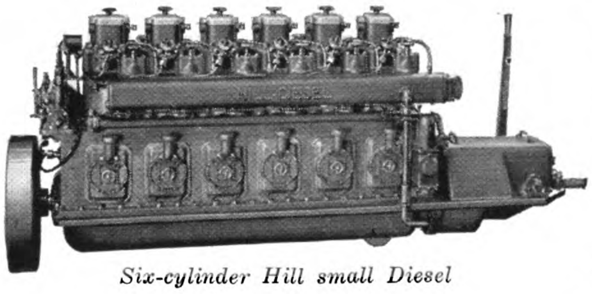
WITH the oil engine thoroughly established in commercial work and rapidly finding its place with pleasure craft, the final day of the gasoline engine for marine and stationary purposes—except for racing craft—is drawing close. For a number of years the gas engine held an indomitable position of prominence where low powers were needed, because no superior self-contained prime mover within its range of reliability, speed and weight had been developed. But the urge for economy is now so strong that even with very low powers, boat owners are moving towards the use of the heavier fuel.

Realizing the potential demand for a Diesel capable of taking a prominent place in the rapidly growing small engine market, the Hill Diesel Engine Company of Lansing, Michigan have produced a new engine of advanced type and as small as 10 horsepower per cylinder at 800 r.p.m., details of which design we now give.

This latest Hill product embodies excellent features of fuel-oil combustion, and employs well tried principles. No claim is made to newness. The main point is the employment of already established methods, which gives a workable combination which is found only in this design.

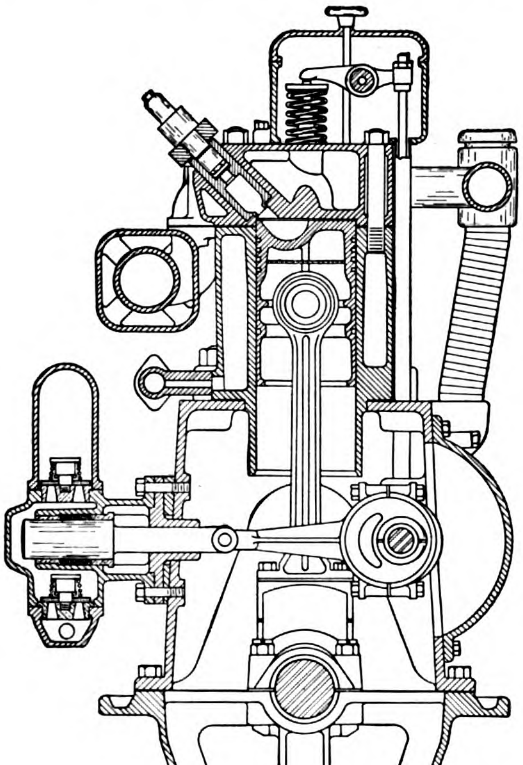
Small Diesels Needed

Before continuing with the details it is well to recall that the oil engine is inherently a more economical machine to operate than the gasoline motor. It is safer, because the fire hazard always attendant with gasoline is eliminated. It is even a more dependable machine when well designed and properly built, and the modern gas engine is by no means unreliable under heavy duty.



Six-cylinder Hill small Diesel

Development of the oil engine until very recent years has been largely confined to comparatively big power sizes ranging from 25 h.p. per cylinder upwards, at 500 r.p.m. Experience gained in the development of the latter, of course, has been of limited value to the prospective manufacturer of small high speed engines. Certain difficulties with fuel pump design and injector as well as with combustion, were encountered, which were different in character from engines of greater cylinder bore. They had to be overcome before a successful small Diesel could be built commercially. The reduction to a minimum number of intricate and complicated parts was essential. The owner of a small boat cannot afford a skilled engineer-operator, and it would effect the oil engine's basic economy. So the task has not been merely one of producing a miniature of its already successful big brother. Quantity of production and lower first cost also have been problems.



Cross section of Hill small Diesel

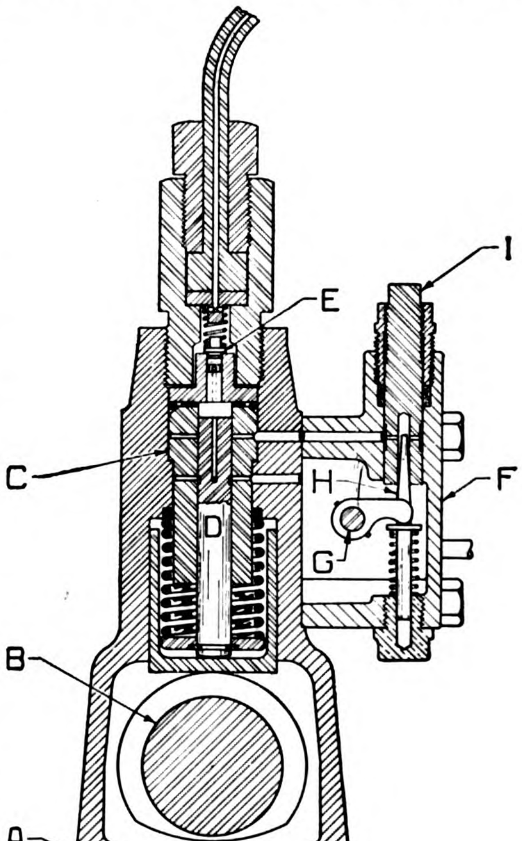
Gasoline Engines Unpopular

Owners of small gasoline boats have been over-burdened with high fuel bills and when insured, with costly premium rates. They have not been satisfied with the erratic performance of their engines. Their state of mind has not been improved by a full knowledge that just beyond their power requirements oil engines were available and that the fuel savings effected enabled their owners to cover their cost in a very short time. Owners of small Diesel workboats have balked at the idea of installing small gasoline engines as auxiliaries, if for no other reason because the stowage of gasoline aboard increased the insurance premiums on the entire boat. Owners of some large motorships have for safety's sake, installed small steam boilers to operate emergency lighting sets and air compressors, notwithstanding the higher first cost and excessive fuel consumption as compared to available gasoline engines.

The Hill Diesel Engine Company's answer to all of these problems is given in their latest engine. Outstanding in connection with this development are a number of features of combustion resulting from the system of fuel injection employed. It consists of a metering pump that delivers the required quantity of fuel under moderate pressure to a spray nozzle of simple design. This nozzle discharges into a pre-combustion chamber, where the fuel is gasified and shot into a dish-shaped combustion space.

The System of Combustion

With this system the preparation of the fuel commences early enough to have it in



Cross section of fuel pump

the proper condition for injection when it reaches the pre-combustion chamber. Ignition by the heat of compression follows. The fuel then gasifies and is forced into the compression space.

A study of the design shows that the pre-combustion chamber has a volume of about one-half of the total compression space. The communicating opening is about ½ inch in diameter. Problems of turbulence are said to be disposed of by projecting a large stream of rich burning gas into the combustion space. According to the manufacturer the fuel reaches the entire volume of air within the cylinder without resistance, and makes but slight contact with surrounding surfaces.

Tests have proven that the best results with the Hill system, are obtained with the closed type of spray nozzle. Open type nozzles accepted by the Hill designers have been used with very satisfactory results. When the fuel pump actuates, a spring-loaded valve in the nozzle opens automatically at about 1500 lbs. pressure. It seats close to a fairly large single orifice. A finely divided spray of oil-fuel appears to be unnecessary with this system, because only a partial combustion of the fuel in the pre-combustion chamber is required. So, compared with conventional pressure atomizers the spray is coarse in nature. Final and complete breaking-up of the fuel occurs when the pressure in the pre-combustion chamber blows the gas into the cylinder combustion space.

After a long series of experiments the engine builders reached a number of rather interesting conclusions, particularly in regard to the question of cold starting. When the engine is cold the viscosity of the fuel at the nozzle is high, and the temperature in the pre-combustion chamber is too low to produce ignition. When the engine turns and fuel is injected, the fuel spray penetrates to the cylinder where the air under compression is much hotter and combustion occurs. After the engine has been running a few minutes the pre-combustion chamber heats and ignition occurs in the regular way. So the pre-combustion space does not have to be heated by any external means, or the fuel ignited by an electrically heated coil.

Noteworthy Details

Constructional details of the engine are well worked out and worthy of attention. Care has been taken to produce a fuel pump of simple design with the body cast en-bloc. Cylinders of hardened steel are inserted. A fuel chest at the side contains measuring valves, one for each pump, individually adjustable, while control of the measuring valves is accomplished by the governor, or by a hand lever. Control of the fuel entering the pump is accomplished by means of ports. About 1/3 of the stroke of the pump is effective. When the plunger has travelled 2/3 of its stroke a groove in the plunger uncovers a relief port in the cylinder. Fuel then passes through a hole in the plunger and back to the fuel chest. Pressure is suddenly relieved and closing of the nozzle valves is assured.

Injection timing is accurately controlled, and permits the best point of fuel injection to be obtained. The injection period terminates at a constant point; the beginning varies with the load. Although this method has been scowled upon by advocates of systems in which the injection starting point remains constant, it has given very excellent results in this particular design. Compression pressure is about 440 lb. so is sufficient for cold starting with fuel of the grades as used in larger Diesels.

Pressure lubrication is used throughout and is carried to all of the principal bearings by tubes and by channels in the crankshaft. A lubricating-oil pump draws oil from an outside reservoir and maintains a pressure on the system. Another pump drains the crankcase and discharges into the reservoir, the oil being cooled and strained as it circulates.

A hammer-forged, heat-treated, and accurately ground crankshaft is employed. It is bedded in bronze babbitt-lined, bearings supported by pedestals in the lower base, with provision made for rolling the bearings out with a minimum of effort. Crank bearings are made interchangeable with the main bearings and are carried in marine type connecting-rods with four bolts. Cylinders are of hard, close-grained iron especially alloyed for this purpose. With cams forged integral the camshaft is hardened and ground all over. Large doors in the upper base permit access to the bearings. The pistons may be withdrawn through the base without removing the cylinder heads. All moving parts are enclosed and protected against dirt.

Of the four cycle type, the engine is supplied in sizes with two, four and six cylinders. The bore is 5 in. by 7 in. stroke and the speed 800 to 1000 r.p.m. On actual test a four-cylinder engine showed a compression pressure of 440 lb., maximum pressure of 510 lb., and mean effective (not m.i.p. pressure of 72.3 lb. The engine delivered 34 b.hp. at 680 r.p.m. with a mechanical efficiency of 80 per cent, and an exhaust temperature of 680 degrees.

The 5 x 7 engine is rated 10 to 12½ hp. per cylinder at 800 to 1000 r.p.m. and is built in two, three, four and six cylinder sizes. The 6 x 10 engine is rated 15 to 20 hp. per cylinder at 600 to 800 r.p.m. and is built in four and six cylinder sizes.

De La Vergne Moves to Philadelphia

THE marine machine shops of The William Cramp & Sons Ship & Engine Building Company, at Philadelphia, which have been idle since Cramps stopped building ships in 1926, are again active.

Tools and equipment of the De La Vergne Machine Co., one of the six subsidiaries of Cramp-Morris Industrials, Inc., are being moved from New York. By November they will all be installed in the Philadelphia buildings. From a manufacturing point of view the move is designed to increase efficiency of operation, effect economies, and to add to the capacity of the De La Vergne Company, one of the pioneer manufacturers of refrigerating machinery and Diesel engines in this country.

For about forty years the De La Vergne Company occupied buildings covering approximately three city blocks at 138th street and the East River in New York City. When the marine machine shops of the original Cramp Company were taken over by the Cramp Engine Manufacturing Company their utility in connection with the operation of the De La Vergne subsidiary was examined by the management. Existing facilities and those that will be added cover between three and four acres of floor space. Proximity of the shops of the I. P. Morris Corporation, another subsidiary, adds to the economies expected to result from the move. Some of the tools and personnel of each company may be used interchangeably, contributing to continual operation and employment and thus smoothing out variations in production.

After a purchaser was found for the New York buildings the sale was completed July 31st, and the company began to move its tools and material to Philadelphia. It is estimated that economies affected by the change will take up the cost of moving within two years.

Electrical Equipment of the Hydrographer

The new Diesel-electric Coast and Geodetic Survey boat HYDROGRAPHER, plans of which were published in the July issue of MOTORSHIP, is now under construction at the plant of the Spear Engineering Corporation, Norfolk, W. Va. Power for propulsion is supplied by two Winton Diesel engine generator units, each developing 450 h.p. at 250 r.p.m. and directly connected to a Westinghouse main generator and a Westinghouse generator exciter. The main generators are shunt wound, separately excited, 250 volt machines of 270 k.w. each. The generator exciters are compound wound, self-excited, 125 volt machines of 25 k.w. each. The exciters furnish excitation to the main generators and power is supplied by separate Diesel generator sets.

For the propulsion equipment the Westinghouse variable voltage system of control will be installed. Arrangements will be made for both bridge and engine room control. The propulsion motor, which will develop 650 h.p. at 125 r.p.m., will be of the double armature type, with 250 volts on each armature. It is a shunt wound machine. Most of the deck and under deck auxiliaries are electrified. These include engine room pumps and compressors, the anchor windlass, capstan, boat hoist and steering gear.

Oil Engine Power Plant Handbook

The Fourth Edition of the Oil Engine Power Plant Handbook now off the press again notches up the standard of quality set by preceding editions.

It is really a very fine work. Though retaining the same outward form as its predecessors, the new volume contains entirely new data on the fundamentals of operating stationary oil engines and of maintaining them with suitable accessory equipment. It contains 286 6-in. x 9-in. pages, and is obtainable from National Trade Journals, Inc. Price $5.00 postpaid.

Interesting News and Notes From Everywhere

FORTY-FOUR Diesel ships aggregating about 350,000 tons are now building in Clyde shipyards.

Three 10,500-ton Diesel t.s. tankers have been ordered by the Russian Soviet Government from the Government shipyards at Nikolaieff.

The Gulf Refining Company have placed an order with Howaldtswerke, Kiel, Germany, for an 11,000-ton motor tanker.

SUD AMERICANO, a 16-17-knot Diesel cargo liner building at Deutsche Werke, will be delivered during October or November of this year.

The motorship MIRABOOKA averaged 16 knots on her last voyage between the United States and the British Isles. Her contract speed was 15 knots.

It is said that launching within six months is called for in the contract to build a Diesel liner for Elder Dempster & Company by Harland & Wolff.

Fifteen knots will be the speed of the Commonwealth & Dominion Line's new motor cargo liner PORT FAIRY, propelled by twin 4000 hp. Doxford Diesels.

All ships under construction at the Cantiere San Marco and San Rocco, Italy, on June 30, were motorships. The total tonnage was 23,680.

Ralph Miller, formerly Assistant Chief Engineer of the Oil Engine Department of the Ingersoll-Rand Company, Phillipsburg, N. J., has been appointed Chief Engineer and O. Walden has been appointed assistant to Mr. Miller.

The new Burmeister & Wain two-cycle, double-acting Diesel engine referred to in our last issue is of about 7000 hp. and will be installed in a motorship to be built for the East Asiatic Company.

The motorship PALLUX, of 12,300 tons dw., was recently launched at Kokums Shipyard, Malmo, Sweden. She is a motortanker of the same type as the M. S. CASTOR, delivered some months ago by the same yard. Her length is 486 ft. 9 in., beam 61 ft. 7½ in., and depth from keel to deck 36 ft. 3 in. The draft is 27 ft. 0⅝ in. Twin Kokum-M. A. N. four-cycle Diesels of 3300 i.hp. will give her a speed of 10½ knots at 145 r.p.m. under full loaded condition. The keel for a 9500-ton dw. motorship will be laid on the vacated berth.

Twenty-four motorships aggregating over 200,000 dw. tons are owned by the Wilhelmsen Line of Norway, and five 10,000-ton dw. 14½-knot motorships are on order for this progressive shipping company.

Following careful model tests at the Hamburg tank, the Oertz rudder and wake propeller were adopted for the Oil Transport Company's new single-screw 3550 i.hp. at 100 r.p.m. Schichau-Sulzer Diesel-driven tanker KATTEGAL.

Eloise is trim and seaworthy.

Reports from the large yawl-rigged Diesel auxiliary, ELOISE, and her owner and master, Commodore J. C. Piver, of San Francisco, indicate that her new 30-hp., Atlas-Imperial Diesel propelled her with great success on a two-months' cruise in Alaskan waters. ELOISE is 86 ft. over all, 75 ft. water-line, 18 ft. beam and 8 ft. deep. She carries two masts, and among her other new equipment are club topsails and Christmas staysails.

This commodious craft, which long has been flagship of the San Francisco Yacht Club fleet, as well as of the Pacific Inter-Club Yacht Association's ships, carries a crew of four men and sleeps twelve in the large main cabin, one stateroom, and the owner's quarters. In every way, ELOISE is designed for comfort and seaworthiness, rather than speed.

The engine room on ELOISE is far aft, just forward of the lazarette. Under her new power she has been doing 9 to 10 knots easily, and running around 12 to 13 knots under both sail and power. In addition to the new engine Commodore Piver added a radio sending and receiving set, a new Protane stove C-O-2 fire extinguishing system and EHG ventilating blowers.

Now under consideration for Diesel-electric or geared turbine drive are seven 450-ft. car ferries for operation in the South. If Diesel-drive is installed there will be eight 900 b.hp engines per boat connected to generators. Twin-screw electric propellers will drive the vessels at 16 knots.

The motorship SILVEROAK, formerly JACKSONVILLE, recent arrived in San Francisco after completing a voyage to the Orient of 7368 miles. She averaged 10.2 knots at an engine speed of 105.2 r.p.m. There was less than five hours delay during the voyage. The owners are well pleased with her performance. She is driven by a New York-Werkspoor Diesel.

Half a knot more than the contract speed was attained on official trials of the motor tanker BENEDICK, recently launched by the Blythewood Shipbuilding Co., Ltd., for the Bear Creek Oil and Shipping Co., Ltd., Liverpool. A speed of 11¾ knots on six runs was attained on a measured mile when loaded.

Aceptance of the bid of the Maryland Drydock Co. for the installation of two of the eight recently completed Diesel engines in the respective vessels selected for conversion to motorships at a cost of $1,064,368 was approved by the Shipping Board. The ships to be assigned the Maryland Drydock Company are the GALVESTON and OLDHAM. Engines to be installed are McIntosh & Seymour.

The motortanker OILPIONEER of 8500 tons dw.c. was launched Sept. 3rd at the Neptune Works of Swan Hunter & Wigham Richardson, for the British Oil Shipping Co. of London. The vessel is 424 ft. in length, 53 ft. 5 in. beam and will be propelled by a seven-cylinder Polar Diesel built by the shipbuilders. The OILPIONEER is thoroughly modern in all respects save one. the cargo pumps are steam driven!

Diesel tanker Sun at San Diego, Cal., following a successful maiden voyage from the Atlantic Coast

Seven 400 ton, 240 s.hp. Sulzer Diesel engined coastwise motorships are building at the De Mass shipyard, Slikkerveer, Holland, for the Royal Mail Packet Company's Far East island service.

A 15,000 tons Diesel-driven passenger ship, which will also carry cargo, has been ordered by the Pacific Steam Navigation Company from Harland & Wolff for their South American service.

The Union Castle Mail Steamship Company has ordered a 10,000-ton twin-screw motor passenger vessel from Harland & Wolff, Harland-B. and W. Diesels developing 7000 hp., will be installed.

BRITISH THRIFT, a motortanker of 620 tons dw.c., was recently launched at the Neptune Works, Newcastle-on-Tyne. Twin Polar Diesels, similar to the power plant in the BRITISH PLUCK, are used for propulsion.

It has been necessary to change the date of proposals for machinery for the two Diesel-electric ferryboats for the Manhattan State Hospital, from Sept. 12 to Oct. 10, 1928. The specified date of delivery of machinery has also been changed and is now April 1, 1928.

Jenkins Bros., valve manufacturer, announces a new line of bronze valve with renewable resilient disc for 250 pounds working pressures. The disc, being more resilient than the metal, readily conforms to the seat, and insures a tight valve without regrinding.

The Pacific Steam Navigating Company, one of Lord Kylsant's companies, have placed an order with Harland & Wolff for a new motorship 550 feet in length. We understand that four twelve-cylinder Harland-B and W. Diesels of the trunk-piston type will be installed.

Fitted to carry general and refrigerated cargo and with special tanks for sweet oil the 10,600 tons dw.c., motorship HAVEL, was recently launched at the Schichau yard in Danzig. A single-acting Schichau-Sulzer Diesel of 4500 b.hp., is calculated to give a speed of 13 knots.

The total steamship tonnage of the Swedish merchant marine has not changed very much since 1914 but the total motor-driven tonnage has increased a little more than 200,000 net register tons, or about 400,000 dw. tons. At present building costs this increase is valued at about 100,000,000 crowns.

ORINOCO, the new Hamburg-American Line motorship, an illustration and brief description of which appeared in June MOTORSHIP, was placed in trans-Atlantic service to relieve the westbound traffic during September. She is a 15½-knot vessel capable of carrying 340 passengers. She called at New York.

H. M. S. MEDWAY, the new 545-ft. Diesel-driven submarine mothership for the British Navy is now fitting out, following her launch at Vickers-Armstrong yard at Barrow last July. British-built double-acting M. A. N. Diesel engines are installed.

Japanese contracts for building of the two new motor vessels, for Nippon Yusen Kaisha Orient-Europe service via Suez, have just been placed with the Nagasaki yard of the Mitzubishi Shipbuilding Company. These vessels will be 505 feet in length, 64 ft. beam, 37 ft. depth and of 11,800 tons gross. Sulzer-Diesels will be installed giving a speed of 17 knots. Accommodation for 125 first class, 69 second-class and 60 third-class passengers will be provided. The first vessel will be ready for delivery about May 31, 1930, and the second vessel about August 31 of the same year; also, coincident with their completion, the steamers ATSUTA MARU, KAMO MARU and KITANO MARU will be withdrawn from the service.

The shipbuilding industry in Japan, according to a recent report from Halleck A. Butts, commercial attache at Tokio, and all dockyards are securing new business. Orders have been received for the construction of several large vessels, the majority of which will be powered with Diesel engines.

A new oil field of considerable extent is reported to have been recently discovered in Reggio Emelia province of Italy. This promises to further stimulate motorship construction in Italy where the largest motorship in the world, the AUGUSTUS, was built.

In a 17-knot, 165 ft. revenue patrol cruiser to be built for the Canadian Government, three 500 s.hp. Winton Diesel engines will be installed. The new vessel will be built by Canadian Vickers Company, Montreal, at a cost of $299,160 and delivered in nine months.

Patrick Henry, a Canadian Diesel-engined fisherman.

The steel motortanker BRITISH PLUCK, constructed by Swan Hunter & Wigham Richardson, Ltd., Newcastle-on-Tyne, to the order of the British Tanker Company, Ltd., recently completed a very successful trial trip. The vessel has a deadweight capacity of 1000 tons and can discharge 200 tons per hour with her Diesel driven cargo pumps. The propelling power is Polar Diesels and she has a speed of 10¾ knots.

Trunk piston type Diesel engines have long been advocated by MOTORSHIP for coastwise vessels and other craft which make short runs. Low cost, light weight and small engineroom space are the benefits to be gained. It remains, however, for foreign shipowners to reap the benefit of our suggestion. The Belfast Steamship Company has ordered three express cross channel (Irish) motorships from Harland & Wolff, which are to be propelled by high-powered, airless-injection Diesel engines. "Shipbuilding and Shipping Record" points out that the adoption of trunk piston engines in high aggregate power is a development of no little significance at the present time. A prominent British shipowning company is contemplating installing trunk piston engines in a large passenger liner of 16,000 s.hp. The machinery will consist of four 12-cylinder Diesels turning at 150 r.p.m. and weighing 170 lbs. per s.hp.

To supersede the RAMONA, 350 hp. steam ferryboat carrying only a dozen autos, the San Diego and Coronado Ferry Company is having built at San Francisco an all-steel 1,000 h.p. Diesel-electric ferry, the CORONADO, which will have a capacity of 52 autos and 300 passengers and will cost approximately $300,000. Plans for the new vessels were prepared by the Bethlehem Shipbuilding and Drydock Corporation. She will be powered with two 500 h.p. Diesel engines of western make, with propellers fore and aft. The design practically duplicates the Key Route Golden Gate ferryboats at San Francisco. CORONADO will be length 190 ft., beam 60 ft., draft 10 ft. Although there will be an upper deck for passengers, most of the Coronado-San Diego traffic is by auto, therefore the main deck will be open, to enable autoists to enjoy the short ocean voyage while remaining seated in their cars.

A profusely illustrated catalog recently has been issued by the McCord Radiator & Manufacturing Company, Detroit, Michigan. It is well written and readily understandable. A sectional cut of the class L. F. mechanical lubricator tells exactly how it works. A description of this lubricator which was recently published in MOTORSHIP explained that it is a device which maintains a constant column of oil between the pump and point of oil delivery.

The General Steamship Corporation recently announced that contracts have been let for the construction of three motorships to be entered into the service of the Westfal-Larsen Line between the Pacific Coast and the East Coast of South America. Each ship, of 14-knot speed and 9000 tons dw., will have space for 1500 measurement tons of refrigerated cargo. They are designed to replace the three steamers EVANGER, HARDANGER and LEIKANGER, and will be ready for August, October and November, 1929, sailing from the Pacific Coast. They will be built in England.

Three years ago Sir John Latta declared that with fuel oil at its then price a motorship was unable to carry cargo more cheaply than a steamship, because of Diesel vessels of 9,000 tons cost $165,000 more than a 10,000 tons steamer. Nevertheless, he subsequently ordered the motorship ANGLO-CANADIAN, a vessel of 9,650 tons d.w. and 2,950 i.hp. On recent trials the ANGLO-CANADIAN attained an average speed of 13¾ knots over six measured mile runs.

Although Diesel fuel-oil costs over $20 per ton at United Kingdom ports, British shipowners continue to lay down new motorship tonnage. Some of our American shipowners with oil right at hand continue to build steamers.

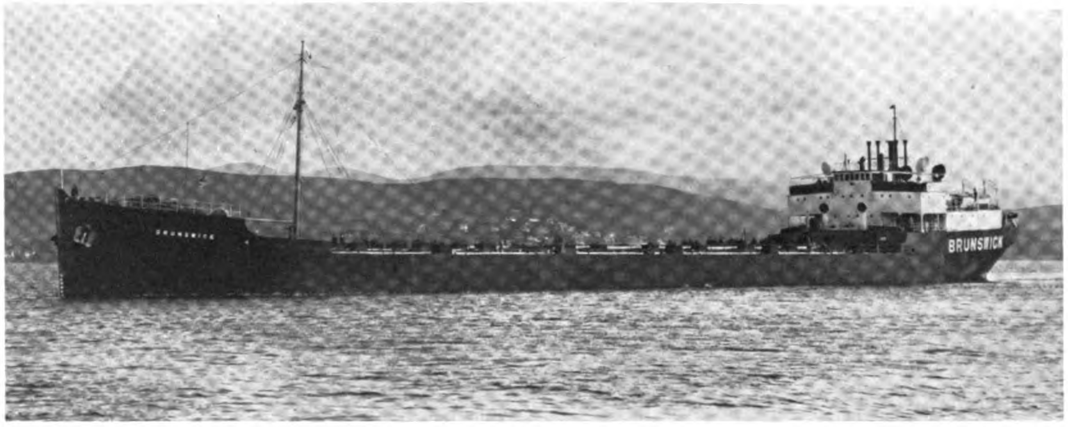
Marine Electricity — A New Industry, is the title of a paper read by A. C. Hardy, former editor of MOTORSHIP, on Friday, Sept. 14, at the Machine Tools and Engineering Exhibition, Olympia Lecture Hall, London, England. The paper is one of the many excellent examples of the thorough manner in which Mr. Hardy handles his subjects. It is constructive, informative and well worthy of the attention of every man interested in modern ships. Space will not permit extensive comment on the paper in this issue of MOTORSHIP, and after all, such comment cannot do it full justice. We look forward with pleasure to the publication of an extract of the paper at an early date.

Flight tests were successfully completed on September 19th at the Packard proving grounds near Utica, Mich., with the first Diesel aircraft engine built. With a radial air-cooled type Diesel developing 200 b.hp. in a regulation Stinson Detroit monoplane, Walter Lees, pilot and Captain L. M. Woolson, chief aeronautical engineer for the company, made two flights. On the first flight several circles over the big testing grounds were made before landing. A second take-off was made and the demonstration was repeated without stopping the motor. The engine is said to be notable for its simplicity and marks a revolutionary step in the development of aircraft power.

A trial speed of 14.4 knots was recently attained by the new 1950 s.hp. Fiat Diesel-engine freighter LORENZO MARCELLO, built at San Rocco, Italy, to the order of the San Marco Line. Her sister ship is called LAZZARO MOCENIGO.

According to a recent report the motorship BIANCA has completed a voyage around the world "without stopping the engine." We assume that this means a six months' voyage without making an involuntary stop at sea or in port. That is a remarkable record.

Specifications for the installation of Diesel engines in six Shipping Board vessels were ordered revised by the board, which announced that bids for the work would be called for on the new basis as soon as practicable. The vessels are the WARD, POTTER, WICHITA, CITY OF ELWOOD, NEW ORLEANS and JEFF DAVIS. Bids for the work were received Aug. 21, but were rejected as too high.



Brunswick, latest addition to the Atlantic Refining Company fleet of Diesel Electric vessels.

A twin screw meat, fruit and general cargo motorship of 11,350 tons dw., the PORT FAIRY, was recently launched from the Swan Hunter & Wigham Richardson, Wallsend Shipyards, for the Commonwealth and Dominion Line, Ltd. She is the first of two similar ships, both sister ships to the PORT GISBORNE and PORT HURON, built for the same line last year. She will have Doxford engines. All auxiliary machinery will be electrically operated. Electric ovens will be used for baking.

Buchi System for 58,400 s.hp. Italian Marine Diesels

Nine fast 4500-ton motorliners, all to have Tosi-Diesel engines equipped with Büchi exhaust turbo charging, are being built for the Florio Line, Italy. Each vessel will have two 8-cylinder, 620 mm. by 975 mm. engines developing 1800 s.hp. apiece at 122 r.p.m.

Tosi-Diesels also will be installed in four motorliners for the Naples-Palermo express service. The latter will have the most powerful *single-acting*, four-cycle engines yet ordered. There will be two engines per boat, each developing 3700 s.hp. at 105 r.p.m., or 7400 s.hp. per boat, from eight cylinders 29.53 in. bore by 47.24 in. stroke at 105 r.p.m. All will have Buchi superchargers, as will a 3900 tons gross, 4200 s.hp. twin-screw Tosi-Diesel motorliner building for the Compagnie Italiana Transatlantica at the Ansaldo yard.

Eight Diesel Yachts Built by Krupps

The following list of motor yachts were delivered by Fried Krupp Germaniwerft A. G. I., Kiel, Germany, since 1918 according to a recent statement of that firm.

Name	Order	Ship Gross Tons	Speed Knots Warrant	No.	Diesel Engines B.hp. Total
NIMET-ALLAH	S. H. Abbas Hilmi II, Khedive of Egypt	830	15	2	1700
RIPPLE	Mr. C. M. Leonard, Chicago	289	12	2	500
WARRIOR (ex-VANADIS)	Mr. Harrison Williams, New York	1159	14.5	2	1650
OCEANUS	Mr. John W. Kiser, New York	400	12.5	2	600
MOBY DICK	Mr. Henry J. Gielow, naval architect, New York			1	180
DAUNTLESS	Mr. H. W. Hanan, New York			1	350
CARITAS	Mr. J. Percy Bartram, New York	380	13	2	600
JEZEBEL	Mr. Thomas L. Chadbourne, New York	500	12.75	2	750

On September 1st there were building in American shipyards 509 steel and wood vessels aggregating 234,268 gross tons.

The 10,000-ton dw. motorships OREGON, WYOMING and WISCONSIN, being built at the Bremer Vulcan yard in Germany to the order of the Compagnie Generale Transatlantique of Paris, will be placed in the France-West Indies, Mexico and Pacific North American service.

Launched recently, and now fitting out is the 17,730-ton displacement motorliner POLEN LAUF. She is being built to the order of the Netherland Sb. Co. at the Netherlands Shipyard, Amsterdam. A Sulzer-Diesel of 7040 s.hp. will propel this ship.

World's Largest Diesel Electric Ship

The tanker BRUNSWICK, largest Diesel-electric ship in the world, was recently completed by the Scotts' Shipbuilding & Engineering Company, Greenock, Scotland, for the Atlantic Refining Company of Philadelphia. She is 469 ft. long, 63 ft. beam and 36 ft. 9 in. deep, with a gross tonnage of 9200 tons and a dw. capacity of 12,500 tons of light oil, and has a designed speed of 11 knots when fully laden.

The main power plant consists of four Ingersoll-Rand type oil engines, built by Carels of Ghent, Belgium, developed 750 hp. each. The engines are each coupled to a 250 volt 600 kw. B. T. H. main generator and an auxiliary generator of 75 kw. mounted on the same shaft. The engines have six cylinders each, 9½ in. bore by 24 in. stroke and are of the conventional I.-R. trunk piston type employing the Price fuel injection system. A double armature type propelling motor rated at 2800 b.hp. at 95 r.p.m., operates under full power at 1000 volts which gave the BRUNSWICK a speed of 11.4 knots during a series of successful trial runs on the Clyde.

Electro-hydraulic steering gear is controlled by Sperry automatic steering equipment from the pilot house. Electric equipment throughout is by the British Thomson-Houston Company, manufacturers in England under G. E. license.

The BRUNSWICK will run to Europe for the first two voyages. No fixed schedule as regards destination of the subsequent voyages has been made. Since she has been constructed abroad she will be barred from coastwise service at home.

RANGITIKI is the first of three 15,000 gross tons passenger Diesel ships building by John Brown for the New Zealand Shipping Company. She was launched August 29th. Each vessel will have a speed of 14 to 15 knots and will be propelled by twin Brown-Sulzer Diesels.

Captain Fritz Buch, formerly on the S.S. CLEVELAND, will be in command of the new motorship ST. LOUIS, which will make her maiden voyage from Hamburg, December 6th. After one trans-Atlantic voyage the ST. LOUIS will make a 70-day cruise to the Mediterranean, leaving New York, January 31st, 1929.

Our two presidential nominees have not made themselves clear conerning their attitude toward the American Merchant Marine. Senator Joseph T. Robinson, Democratic nominee for the vice-presidency, in his campaign speeches, leaves no occasion for doubt. He is to be commended for the interest and support he is giving to the very important matter of keeping American ships on the world trade routes.

The motorship TWIN PORTS of the Detroit-New York Transit Company recently made a record run from Troy to Oswego, New York. She left Federal Lock the morning of September 2, at 7:53 and entered Lock No. 8 at Oswego, New York, 11:13 P.M., September 3, making the run in 39 hours and 20 minutes. Canal officials at Oswego say this time has never been made before.

Sea-post Service on M. S. Santa Maria

A saving of more than a day will be effected at each port of call in mail delivery under the sea-post service recently put into operation between New York and ports on the West Coast of South America by the foreign branch of the United States Post Office Department on the Grace Line motorship SANTA MARIA for Havana, the Panama Canal and ports in Peru and Chile.

The New Grace Motorliner

SANTA BARBARA, a sister ship to the SANTA MARIA, which was fully described in the June and several previous issues of MOTORSHIP, arrived in New York last month where she was open for inspection a few days and then loaded for her maiden voyage to the west coast of South America. Both vessels were built by the Furness Shipbuilding Company, Haverton Hill-on-Tees, and are powered with twin Sulzer Diesels, built at Winterthur, Switzerland, and of 5000 i.hp. each, at 100 r.p.m. The principal dimensions of the SANTA BARBARA are:

Displacement	15,000 tons
Length	485 ft.
Beam	64 ft.
Power	10,000 i.hp.
Speed	16½ knots
Cargo capacity	7000 tons
Passenger capacity	159 first class

Sailing from New York on September 27, the SANTA BARBARA will touch at additional ports of call made possible by her greater speed over that of the steamship she replaces.

Diesel Achievements by Sulzers

About Thirty Per Cent of World's Motorship Tonnage Building Is Having Their Design of Oil Engine

WITH two big Sulzer Diesel-engined passenger liners, several tankers, and one large yacht now in the service of Americans, progress with this well-known design of engine is being watched far more closely in this country than heretofore. Particularly as Sulzer Bros. are continuing to build single-acting engines as high as 10,000 shaft horsepower, which many engineering men consider to be well into the range of the double-acting engine. Sulzers, however, have not lost sight of the double-acting principle, and as our readers are aware have had a big single-cylinder two-cycle, d.a. "development-unit" running in their plant at Winterthur, Switzerland, for about two years. This unit has a normal output of 2000 s.hp. at 100 r.p.m., from a cylinder of 35.43 in. bore by 55.12 in. stroke, and, with supercharging has been loaded up to 3500 i.h.p (about 2500 s.hp.). This would mean that with an eight-cylinder engine, no less than 20,000 s.hp. is available today to the shipowner, or 80,000 s.hp. for a quadruple-screw motorliner.

We cannot overlook the fact that Sulzers—always an important factor in Diesel progress — have made tremendous strides with marine-type Diesels since the war. They now hold a foremost place in Europe, and rank side by side with the M.A.N., also now exponents of the high-powered two-cycle engine. At the close of last year over thirty per cent of the world's ocean tonnage under construction was being equipped with Diesels built by Sulzer Bros. and their licensees. It must not be forgotten too, that back in 1912 Sulzer produced 2000 s.hp. from a single cylinder, 39.37 in. by 43.31 in., *single-acting*, two-cycle Diesel at 150 r.p.m.

For marine work Sulzer's policy is to adhere to the single-acting design for all Diesels under 10,000 s.hp., and in this they stand alone. But, their decision must be given the respect due the extensive experience with which it is adequately backed. In the latter, however, they are not alone; and, of two engineering opinions, both—with qualifications—can be right.

It often has been wondered why Sulzers have been so reluctant to build double-acting marine engines for vessels scheduled on long continuous runs. Sulzers point out that instead of introducing engineering novelties and using the ships of friendly companies as an experimental field for immature designs, their policy has been to give first consideration to the reliability of ships in service. This policy, which the firm has pursued from the very first, has primarily contributed to the ever increasing confidence shown in the large Diesel engine as a reliable machine for the propulsion of ships.

For the fast motorliner, owners demand that the vessel can run year after year without interruption at a certain specified speed. In order to ensure the engine-room staff having proper shore leave, the whole work required from them when the vessel is in port must be confined to the work of overhaul demanded as minimum by the Classification Societies. The design of the entire power plant has to be so carefully studied, that all parts subject to overhaul can be dismantled in as short a time as possible. Full attention is to be paid to balancing and to critical speeds to prevent any disturbing hull vibrations.

It can safely be asserted that the single-acting two-cycle Diesel engine complies closely with these requirements. At their official trials, most of the ships equipped with Sulzer Diesel engines have not only attained the expected maximum speed, but have exceeded it. Individual ships have repeatedly arrived too soon at their destinations. The great overload capacity of Sulzer engines also allows a higher speed to be attained at any time. For example, during the recent official trials of the Dutch motorliner CHRISTIAAN HUYGENS, her ten-cylinder oil engines, designed for a normal load of 5800 s.hp. at 115 r.p.m., were kept running for 26 hours, developing 6300 s.hp. at 118 r.p.m.

No annoying vibration has been felt on any of the ships equipped with Sulzer Diesel engines, although the engines run constantly at the guaranteed speeds.

The 23,000-ton passenger motorliner AORANGI, propelled by Fairchild-Sulzer Diesel engines, has always well maintained her stipulated speed of 16½ knots. In the 3 years' service already completed she has only missed one voyage and that was to allow of the periodical survey being made. The vessel stops 5 days in Vancouver and 5 days in Sydney, and in each port 1½ days are required for disinfecting, so that only 3½ days are left for carrying out the normal overhaul, but this short time has up to now proved to be quite sufficient. The actual running time of the ship amounts to 67% of the total service time. Her remarkable 200,000-mile record was outlined on page 580 of MOTORSHIP, July issue by Oliver F. Allen of the International General Electric Company.

The tanker LUMEN, equipped with two 1250 s.hp. Brown-Sulzer Diesel engines, surpassed even this figure, having been at sea 311 days per annum, which represents 85 per cent of the total service time.

Single-Acting or Double-Acting

WITH world-renowned Diesel-engine builders sponsoring both single-acting and double-acting motors, it is only natural that shipowners should be voicing a demand for a final decision on their relative merits. Such demands are based on the gratuitous assumption that one of the two must necessarily be superior, and leave out of account the very real possibility that both may be equally good.

The merits of an engine are deeply rooted in the past practices and developments of the firms that build it. A design that is excellently carried out by one company may be a total failure in the hands of another. Radically different designs can be equally excellent, provided they are backed with the right manufacturing tradition and are basically correct.

The very strong plea of a well-grounded advocate of the single-acting engine is embodied in this article. Our pages are also open to the views of responsible Diesel builders who may desire to comment, in a purely engineering way, on some of the views expressed.

The good results obtained with passenger motorliners and careful consideration of the advantages and drawbacks of the different types of engines and various means of transmitting power from engine to propeller, has led Sulzer Bros. to maintain that for passenger liners requiring up to 40,000 s.hp. today the single-acting two-cycle engine with direct coupled propeller shaft offers the soundest guarantee for trustworthy and all around satisfactory working, assuming, that powers exceeding 20,000 s.hp. would be transmitted through four propeller shafts.

But, this does not mean that Sulzers consider 10,000 s.hp. as the limit of output for a single-acting two-cycle Diesel engine. Whether single-acting or double-acting two-cycle engines with direct drive, Diesel-electric transmission or high-speed engines with reduction gear offer the greatest reliability for higher powers, remains at present a debatable question. It is perhaps unnecessary to mention that the slow-speed single-acting crosshead four-cycle Diesel engine is considered by many to have passed its limit at outputs of 550 s.hp. per cylinder, so can no longer come into consideration for high powers in open competition. However, in the United States the trunk-piston four-cycle engine of high speed in conjunction with electric drive is now being developed in multiple units for higher powers to a greater extent than in Europe and may prove a strong competitor to the big two-cycle engine.

For large passenger liners Sulzer Bros. build six, eight or ten cylinder engines. These three types are distinguished by regular torque, excellent balancing, and the absence of any perceptible sign of torsional vibration in the shafting or any cross-vibration of the columns. Scavenging-air for their eight- and ten-cylinder engines is generally supplied by independent, electrically-driven turbo-blowers; for six-cylinder engines scavenging-air pumps, built directly on the engine, still come into consideration. The injection-air compressors are driven direct from the crankshaft. In order to eliminate free forces of the first order in engines for passenger liners the compressor is subdivided into two-cylinders, with their cranks set at 180 deg. to each other.

The first point which strikes an engineer looking at the Sulzer engine, is the robust and yet pleasing design. Bedplate and columns constitute a rigid system insuring the engine

and crankshaft against any distortion, independently of the foundations. It is to a large extent owing to this well thought-out sturdy design that no trouble has ever been had on a Sulzer-engined ship with bedplates, columns or crankshaft.

Care has been taken to ensure complete enclosure of the crankcase, so is free from oil vapor. Handy inspection-hole covers, fitted in convenient positions above the shower of oil, allow the working parts to be inspected while the engine is running. When overhauling the engine, the doors on both sides are opened so the accessibility of the driving gear is better than with many engines having single guides, only accessible from the outboard side of the engine.

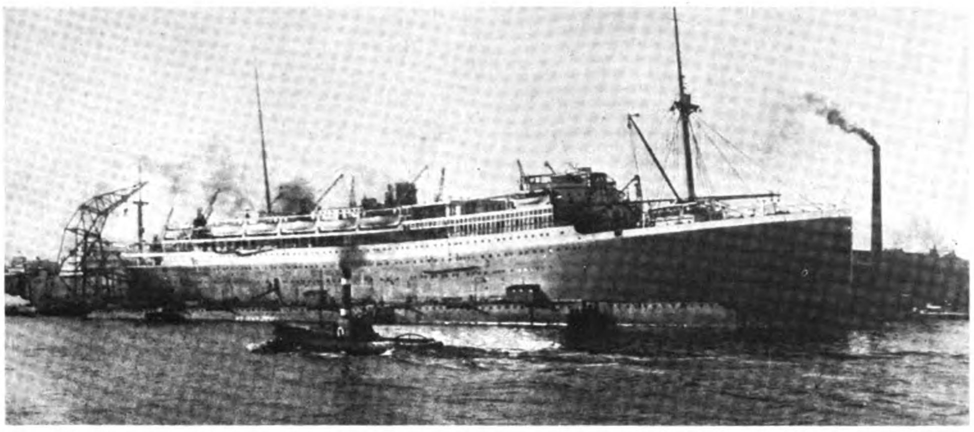
The thrust bearing, a single-collar bearing of Sulzer design, is firmly connected to the bedplate and thus forms a part of the engine. This arrangement insures absolutely accurate alignment with the main bearings, and is recognized as excellent engineering by many shipbuilders and shipowners. The thrust bearing is connected to the same pressure lubricating system as the bearings, and does not tend to heat or seize even when working under the most severe conditions.

When comparing Sulzer engines on a length, weight and price basis, it must not be forgotten that if equipped with the thrust bearing and engines a special thrust-bearing with special expensive foundations does not have to be provided at an extra cost. With a separate thrust-bearing it is a difficult matter to ensure maintenance of exact alignment if any deformation occurs in the ship's hull. Even the bearings in the engine itself may be thrown out of alignment under such conditions Sulzer claims, which may result in dangerous heating of the latter, also possibly in fracture of the shaft.

Subdividing the injection-air compressor implies an increase in length, weight and price of the engine, but these drawbacks Sulzer's designers consider are more than compensated for by the advantages gained of greater reliability of working a better power reserve and perfect balancing. It may, however, be mentioned that the latest design of thrust-bearing with flywheel outside, and the latest design of the double compressor for the eight-cylinder engine with cylinders of 680 mm. bore, enables the total length of the engine to be reduced from 18,335 to 17,177 mm., i. e., by about 6 per cent.

Length and height, or height required for dismantling the piston, play quite a different part in a purely passenger liner than in a cargo boat. In the latter, the engine should be as short as possible in order to gain cargo space. For twin-screw cargo boats and tankers, four-cylinder engines with electric-driven turbo blowers for scavenging have mostly been adopted by Sulzers. In the modern passenger liner an endeavor must be made to keep the engine room as low as possible in order to have the maximum deck space. The length of the engine is practically of minor consideration—the number of cylinders can be as high as eight or ten. This keeps the cylinder dimensions small, and the height correspondingly low.

The height required for withdrawing the pistons of a double-acting engine is about 50 per cent more than in the case of a single-acting engine with the same number of cylinders and developing the same power. In a 20,000-ton passenger liner part of at least one or two valuable decks have to be sacrificed. The slight reduction in price from which the purchaser expects to benefit at first, is wiped out by the loss of valuable deck space. This is an additional reason given by Sulzers for preferring the single-acting two-cycle engine.



The motorliner Christiaan Huygens of the Netherland Steamship Company, which is powered with two 5800 s.hp. Sulzer engines, operating at 160 r.p.m.

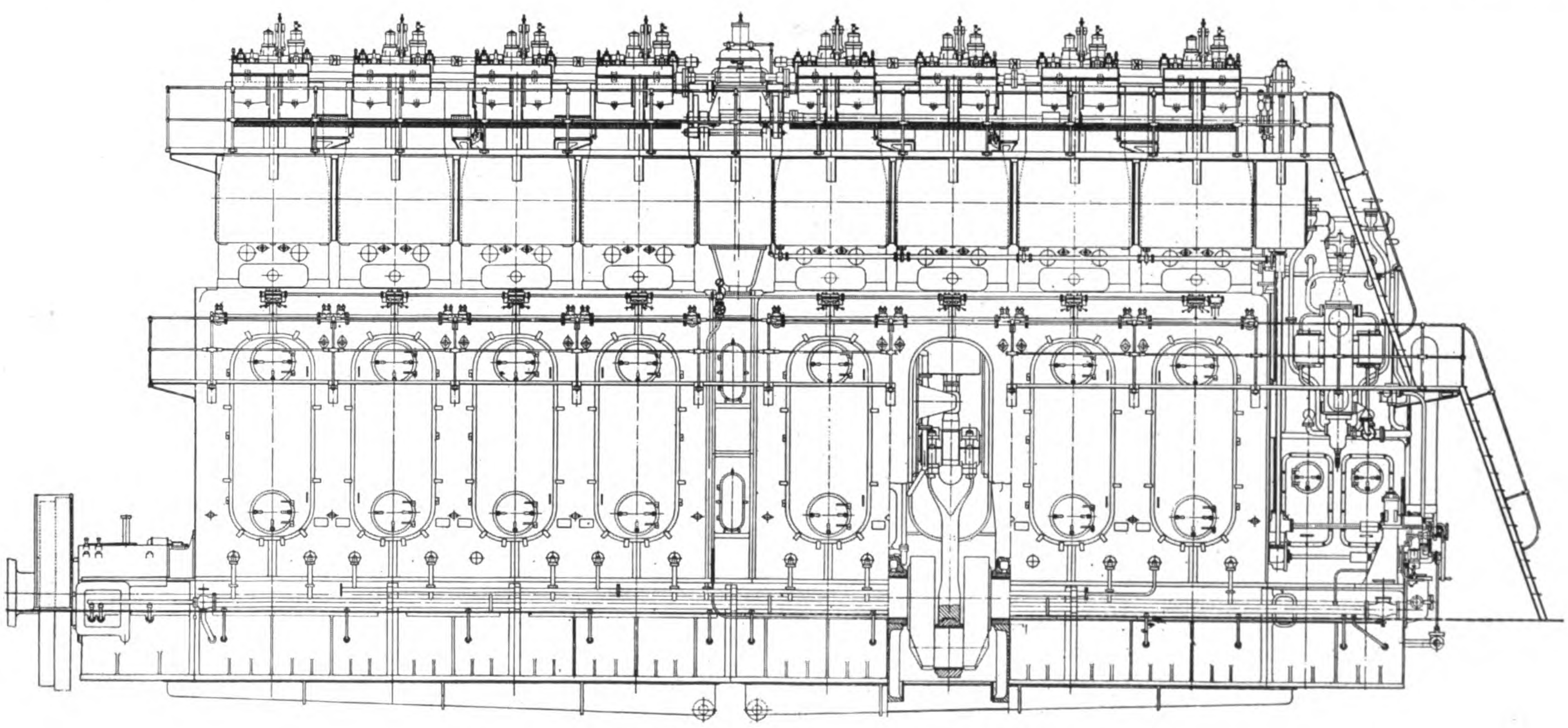
The working cylinders of the latest single-acting Sulzer two-cycle engines are provided with a so-called "lantern." This is a distance-piece located between cylinder and crankcase and fitted with oil-scrapers to prevent the dirty lubricating oil from the cylinders reaching the crankcase. This advantage the designers believe justifies the somewhat increased height it entails.

The design of the cylinder head of the Sulzer single-acting two-cycle engine is also of interest. Formed as a simple solid of revolution with a single, central opening for taking the combined fuel and starting-air valves, it is free from residual casting stresses. Because of the method of cooling and its freedom to expand in any direction, the heat stresses cannot become dangerously high. In consequence of this, the number of cracked cylinder heads has up to the present been less than 1 per cent of the number of heads in service.

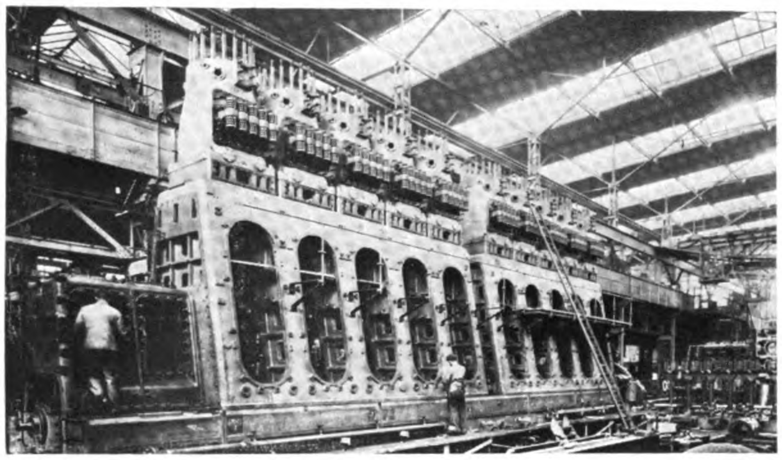
The fuel valve is the only valve exposed in service to the high combustion pressures and temperatures. The simple plate pulverizer can easily be adjusted to suit fuels of very different properties.

While Sulzers advocate the two-cycle Diesel for marine work, it must not be forgotten that for decades they have taken part in the development of the four-cycle engine. There are thousands of Sulzer four-cycle engines in service in units up to 1500 hp. Sulzers are consequently well aware of the advantages or disadvantages of the four-cycle type. They adopt it mostly for smaller units, and chiefly for stationary engines and for locomotives and rail cars.

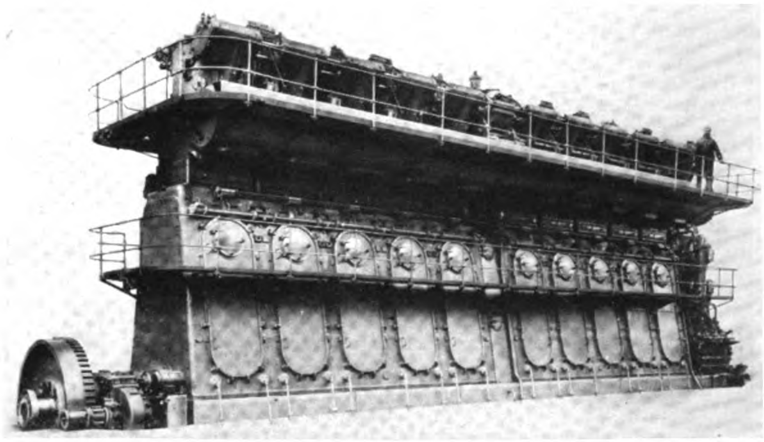
The original Sulzer system of scavenging with a double row of ports has up to the pres-



Side elevation of Sulzer 8-cylinder, 5800 s.hp. Diesel engine



Ten-cylinder Sulzer Diesel building in Winterthur shop



Ten-cylinder Sulzer Diesel, rated at 7500 s.hp. at 115 r.p.m.

ent maintained its position. The scavenging obtained is so efficient that all engines continuously maintain their rated mean-indicated pressures and, in addition to that, stand an overload of 20 per cent with the exhaust still clear.

Starting is effected by delivering air and fuel to groups of cylinders in turn. The gear is operated by means of a servo motor, the starting and stopping of the fuel pumps, and the opening, closing and emptying of the main starting-air piping to each engine, being effected automatically. Starting and reversing gear are inter-locked, so that it is impossible for any mistake to be made when maneuvering.

An approved type of ball governor puts the individual fuel pumps out of action one after the other, prevents the speed of the engine becoming dangerously high in case the propeller leaves the water or is lost entirely. It has been proved in actual service that the engines can work with certainty and without any great fluctuation in speed, even in the heaviest seas, without any adjustment of the hand regulation.

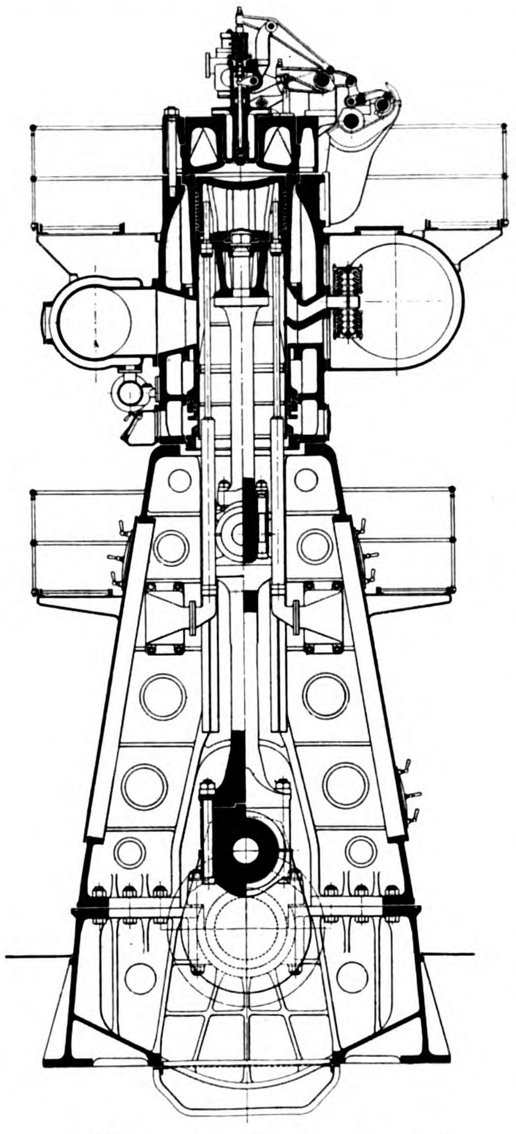
The working pistons have been gradually developed to the design used today, without any sudden changes, radical in nature, having ever been made. Even if the piston cooling system should fail, the pistons can work safely for a short time without risk of cracking. The use of special cast-iron for the upper part of the piston and the special method of cooling, depending on the splashing action of the water, enables sea-water to be adopted as the cooling medium, without any troublesome deposits or pitting being caused in the pistons.

Sea-water cooling makes it unnecessary to carry a supply of fresh water or cooling-oil, or to have special coolers and special circulating pumps. A plentiful supply of cooling medium is always at hand and at the lowest possible temperature. Since the piston cooling works without internal pressure and the water flows out freely into large funnels, there is no pressure to necessitate the stuffing boxes being kept absolutely water-tight. Any water carried over is wiped off in a water catcher and led back to the funnels outside the engine. The central jet pipe formerly used by Sulzers, and which was found liable to wear if not perfectly in line, has been replaced by a short fixed jet nozzle and a pressure nozzle in the running pipe. Replacing of the jet pipe, and also the delicate work entailed in carefully adjusting it, is eliminated.

When the engine is at work, the working piston can be observed for about three-quarters of its length, while in a double-acting engine, this most important of all parts of the engine is entirely enclosed in the cylinder. Piston-rods, crossheads and connecting rods in the Sulzer Diesel engine are all of robust construction. The crossheads are of high-grade crucible steel; the small-end bearings work under high-pressure forced lubrication and the specific pressures on the bearings surfaces are kept within moderate limits. In the latest design, the white metal is cast into the small and big-ends of the connecting rod, avoiding the use of bearing shells.

No annoying vibrations have ever been noted on any passenger liner equipped with Sulzer Diesel engines. This can to a large extent be attributed to the particular attention paid by Sulzer Bros. from the very beginning to the questions of balancing and critical speed. In eight and ten cylinder engines the tangential force diagram shows almost no fluctuation. This and the above-mentioned robust construction of the columns contribute to smooth running.

When it is considered that the reaction to torque is transmitted over the crosshead guides to the columns and over the bedplate connections to the hull of the ship, it is easy to see why the single-acting two-cycle engine should run smoothly. The variations in the tangential force diagram of the Sulzer two-cycle engine are, for a six-cylinder engine, about equal to those of a triple- or quadruple-expansion steam engine; the diagram for eight and ten cylinder engines approaches that of the steam turbine.



Cross section of 5800 s.hp. unit

The balancing of the six-, eight- and ten-cylinder two-cycle engines is practically perfect. The group of working cylinders alone, without the scavenging air pumps and air compressors, has no free forces of the 1st order and no free forces of the 2nd order. If a single-cylinder compressor is fitted, this gives rise, in a two-cycle as well as in a four-cycle engine, to free forces of the 1st and also of the 2nd orders. In order to eliminate the free forces of the 1st order, the compressor of six-, eight- and ten-cylinder Sulzer engines is subdivided into two cylinders with the cranks set at 180 deg. to each other. The unbalanced moments are also very slight.

The double compressor is set so that its free moment partly compensates that of the working cylinder. In addition, it is known that in general no vibration is caused in the engine or in the ship from moderate, free moments in the vertical plane and axially. The theory of these free moments holds, however, only for a sufficiently rigid construction. Where the construction is flexible the free moments of the two halves of the engine, acting opposite to each other, may cause distortion in the engine itself. This is transmitted to the bedplate and the hull of the ship.

The critical speed conditions for crankshafts and intermediate shafting in six-, eight- and ten-cylinder single-acting Sulzer two-cycle engines are very favorable.

Below is given a summary of the critical speeds of the first degree (vibration with one node) in the Sulzer engine. These are dangerous particularly for the shafting between the flywheel and propeller. The critical speeds of the second degree (vibration with two nodes), which affect the crankshaft, are also given.

The figures hold for engines with cylinders of 680 mm. bore and 1200 mm. stroke, developing 500 b.hp. per cylinder at 100 r.p.m.

Six cylinders n..	1st degree /	6th order	32 r. p. m.
crit...	2nd degree /	9th order	114 r. p. m.
	2nd degree /	12th order	85 r. p. m.
Eight cylinders n	1st degree /	8th order	27 r. p. m.
crit...	2nd degree /	8th order	125 r. p. m.
	2nd degree /	12th order	84 r. p. m.
Ten Cylinders n	1st degree /	10th order	22 r. p. m.
crit...	2nd degree /	5th order	160 r. p. m.
	2nd degree /	10th order	80 r. p. m.

From the foregoing it can be seen that the dangerous critical speeds of the 1st degree lie below the minimum speed of the engine. On the other hand, the dangerous critical speeds of the second degree lie safely above the normal speed. The critical speed of the second degree 12th order, for the six- and eight-cylinder engines is not dangerous. In the ten-cylinder engines the node of the

(*Continued on page* 861)

Diesel Engines for Naval Vessels

A Comprehensive Outline of Advantages to be Gained by Diesel Drive

(Part II, Continued from Sept. issue)

By A. M. Proctor, Captain, Ret'd, U. S. Navy

THE amount of scavenging air required will be about 274,000 cu. ft. per min. At this pressure about 15 hp. per 1000 cu. ft. would be required at the blower shaft which would make the total shaft horsepower equal to 4185. To provide ample reserve capacity a conservative allowance would be 6000 s.hp.. With this large scavenging power it would be, obviously, undesirable to use electric drive with a transmission loss of at least 30 per cent.

Four 12-cyl. V-type, 12 in. x 12 in., Beardmore engines would provide this power on a weight per b.hp. of 15 lbs. at 900 r.p.m. The weight of the blowers and engines would be somewhat less than 50 lbs. per b.hp., which would give a total weight of 300,000 lbs. With a blower on each end of the engine, geared two to one, the over all length would be something less than 30 ft. With eight scavenging blowers of capacity of each would be about 35,000 cu. ft. per min., which is about one-half of that of the largest size in use. At normal continuous sea speed the scavenging air pressure would be reduced, and the power could be supplied by two of the foregoing engines at less than the normal rating. The weight of the oil and water pumps and air bottles can be taken at 0.3 lb. per cu. in. cyl. vol. which results in a weight of 186,000 lbs.

The total weight of the Diesel engine installation complete will be as follows:

Engines	1,818,000 lbs.
Scaveng. engines and blowers	300,000 lbs.
Oil and water pumps, etc.	186,000 lbs.
Total	2,304,000 lbs.
Wt./s.hp.	25.5 lbs.
Wt. per cu. in. cyl. vol.	3.7 lbs.
Wt. of retained auxs.	1,489,600.0 lbs.
Total machinery wts.	3,793,600 lbs.
Wt./s.hp. all machinery wts.	42.1 lbs.
Wt. available	4,256,000 lbs.
Balance	462,400 lbs.

In comparing engines ranging widely in size, speed and specific weight the effect of Mr. Normand's statement of the laws of similitude are often overlooked.* The weight per s.hp. (25.5 lbs.) seems to be a very drastic reduction from the weight of 109 lbs. per b.hp. for the Fiat engine.

Applying the ratio of the factors in the formula:

$$\text{Wt./s.hp.} = \frac{W \times v \times 33{,}000}{\text{M. E. P.} \times \text{piston speed}}$$

we have:

Ratio wts. cu. in. cyl. vol. $= 3.7/6.5 = 0.57$.
Ratio of strokes $= 39.1/25 = 1/56$.
Ratio piston speeds $= 1600/984 = 1.63$.

Allowing for no increase in m.i.p. over the Fiat engine, the weight reduction will be in the ratio $0.57/1.56 \times 1.63 = 0.23$. This factor applied to the weight of 109 lbs. per b.hp. brings the weights of the proposed engine down to 25.1 per b.hp.

The balance available on this schedule, amounting to about 206 tons, is about 30 per cent of the estimated retained weights, after steam plant had been removed, and is somewhat greater than the total weight of the electric plant. There are a few items which will affect this total, but their effect will be negligible.

Accessories Required

Heating and distilling must be provided for. The weight of the distilling plant was included in the estimate of retained weights, and in view of the fact that the fresh water requirements for a Diesel ship will be less than one-half that of a steam ship, the saving on weight of the distilling plant would be sufficient to provide a small distilling boiler. The electric plant must be Diesel driven, but it is doubtful if there would be any material increase over the present weight of turbines and generators if modern high speed Diesels were used. Allowing 100 lbs. per kw. the total weight would be not over 40,000 lbs., less than 10 per cent of the balance available.

This installation has so far been considered on the basis of its overload full power rating. When measured on the basis of the continuous steaming rating of 60 per cent full power, the results as compared with the most recent commercial practice are not extreme.

The power would be about 54,000, the speed would be about 30 knots, and the engine characteristics would be as follows:

R.p.m.	320
Piston speed	1333 ft. min.
Power per cylinder	750
M.e.p.	60 lb. sq. in.
Mech. efficiency	85 per cent
M.i.p.	70.6 lb. sq. in.
Wt./s.hp. Diesel weights	42.7 lb.
Wt./s.hp. all machinery weights	70.2 lb.
Height, approximately, overall	18'0
Length engines, approximately	140'0
Length present engine and boiler rooms	184'0
Balance available auxiliary machinery for Diesel engines	44'0

OUR Navy has fallen astern in development of the naval Diesel engine. Knowledge gained by a careful study of achievements of others may be of inestimable value to the one who has time to wait. But that policy means being always in the rear. We have no time to wait for other nations to establish precedents. Common sense teaches that we should be leaders when an engineering development of vital importance is involved.

As the leading nation of the world we cannot profitably experiment with a policy of procrastination. That is precisely what is now being done. Let our Navy Department proceed with the construction of Diesel machinery of equivalent power to a battle cruiser. A bold, costly step, but think of the value of success—for both our naval and merchant fleets. It is the duty of the Secretary of the Navy to enlighten Congress, and urge an appropriation.—Editor.

The conditions of a naval 24-hour trial are somewhat more severe than those considered proper for continuous steaming in commercial ships. The 3000 s.hp. Augsburg submarine engine was installed in a number of merchant ships. This engine was rated at 1500 s.hp. or 50 per cent of its full power Naval rating.

Two Versus Four Cycle Engines

It is by no means certain that the two-cycle double-acting engine, which has been considered in connection with this problem, offers a better solution than the four-cycle double-acting engine. For large cylinders having a ratio of stroke to bore of 1.5:1 or greater, the trend has been towards the two-cycle engine, and the weight of engineering opinion is on the side of that type. For small high-speed trunk-piston engines, the advantage so far is in favor of the four-cycle. For intermediate types the subject is a debatable one, and when the advantages and disadvantages of the two types are analyzed, it is a difficult matter to say that either type appears a better solution of the problem than the other. All things being equal, the two-cycle engine with a ratio of effective stroke to stroke of 0.75, is capable of developing about 50 per cent greater power than a four-cycle engine of the same dimensions.

But all things are not equal. With the stroke as a limiting factor, a larger cylinder diameter can be used with the four-cycle engine without reducing the ratio of effective stroke to bore below that necessary for reasonable economy, and in a four-cycle engine, with moderate assisted scavenging, a mean indicated pressure about 60 per cent greater than the maximum with a two-cycle engine is possible. The four-cycle engine can be designed with a relatively smaller distance between cylinder centers. Assuming a slightly lower mechanical efficiency of 87 per cent (the mechanical efficiency of the Augsburg submarine four-cycle S. A. engine is about 89 per cent, without air compressors and attached pumps) a mean indicated pressure of 150 lb. per sq. in., the four-cycle double-acting engine would develop the required b.hp with a cylinder diameter of about 23.5 in.

The weight and space of the two types would not be materially different, and the decision as to the type used resolves itself into a matter of engineering opinion, or of preference on the part of the designer.

Heat Stresses Not Great

In either case, with the small cylinder diameter, the heat stresses involved would be very moderate in comparison with those of existing engines of larger size. As there is no precedent for an installation of this kind, it is obvious that there are many objections which can be raised. Examination of the sub-

*"Law of similitude regarding questions of Naval Construction." J. A. Normand, before l'Association Technique. Journal A. S. M. E., May, 1895.

ject will disclose, it is believed, that there is nothing abnormal about eighteen cylinders on one shaft. A 15-in. shaft diameter will be sufficient to handle the bending and twisting stresses involved, which will be somewhat less (based on the ratio of shaft diameter to cylinder diameter), than that found in a number of existing engines.

The controlling factor is the bearing load, and this has led to a progressive increase in Diesel engine shafts up to a point where, in six-cylinder engines, the twisting stress is practically negligible; when not superimposed on those due to torsional vibration.

We are very close to 1600 ft. piston speed now, and all of the other design factors are capable of exact determination and are justified by present practice. The main objection to an installation of this character is that it *is* without precedent; but if we will look back over the last three years and take the high-speed airless-injection Augsburg engine, the weight of which is stated to be 55.0 lb. per b.hp., as a measure of progress during that time, knowing the intensity of the research work being done on the Continent of Europe, we can without overstraining the powers of imagination see an engine of this character in the not very distant future.

Light Weight Engine Development

There is at present an intensive effort being made to develop a light-weight high-speed Diesel for locomotives. This, however, will be in far smaller powers than required in naval engines. In naval engines, where low weight per s.hp. is a controlling factor, a marked differentiation of type from the commercial engine, will result from a consideration of all of the factors.

This resultant engine of the lowest possible weight per s.hp. must be produced by a combination of the lowest possible specific weight, the highest practicable piston speed, the highest practicable speed of revolution, and the highest value of mean indicated pressure.

The high speed commercial engine, of which the Augsburg engine is said to be the most advanced example at present has a relatively small weight per s.hp. as a result of the high piston speed and high revolutions. This type is being developed to meet the requirements of generator drives for power plants. There has been no incentive towards reducing the specific weight sufficiently to justify the increased expense involved, and a high mean indicated pressure is not consistent with fuel economy.

An Engine Suitable for Naval Purposes Can Be Built

And it will be built when the necessity for it is recognized and when some governmental agency is willing to spend the very considerable amount of money necessary to its development. This will come when the fact is generally recognized that the inherent possibilities, based on fuel consumption, are something more than twice those of the steam plant, and at cruising speeds for Naval vessels the ratio will be at least four to one.

There has recently been an intensive effort to improve the steam plant by the use of higher pressure and higher temperatures. There has been a very material reduction of weight in commercial installations, because of the increased pressures, *but there is room for doubt as to whether there has been any improvement in economy sufficient to justify the price paid in wear and tear, with increased upkeep charges because of these high pressures and temperatures.*

Thirty Years Sees No Advance in Steam Economy

More than thirty years ago the steamer INCHMONA, now long forgotten, established a record for economy. The boiler pressure was 255 lb. per sq. in. On four trial trips "the average consumption of north country coal was 1.07 lb. per i.hp. per hour. The coal used during the trials was carefully weighed for the four separate runs in the presence of four separate groups of visitors." Several years later to two other ships, the INCHDUNE and INCHMARLO. were built to have a somewhat higher boiler pressure—267 lbs. per sq. in. In regard to one of these ships it is reported that "the general result is that on an extended trial from Hartlepool to Dover the coal consumption was at the unprecedentedly low rate of 0.97 lb. per i.hp. per hour." This rate on a fuel oil basis would be 0.71 lb. per i.hp. per hour, which would give about 0.77 lb. per s.hp. per hour.[1] The figure for the INCHMONA on an oil basis would be 0.78 lb. per i.hp. per hour, and 0.85 lb. per s.hp. per hour.

Up to the time when the competition of the Diesel engine began to be felt there has been little improvement. Writing in *Brassey's Annual*, 1927, Professor Biles states: "When the war was over the new passenger vessels laid down followed the pre-war intended and actual practice, and commercial results represented by 1.25 lb. coal per s.hp. hour, equivalent to 1.12 lb.[2] coal per i.hp. hour were expected and obtained, and results with oil-fired boilers represented by about 0.8 lb. of oil per s.hp. hour were also obtained."

Among the outstanding attempts to improve the steam plants was that of Sir Charles Parsons, who saw "that to meet this challenge of the Diesel engine, something had to be done to improve the efficiency of the steam turbine," and who in collaboration with Yarrow and Denny built the KING GEORGE V. The trials of the vessels were run in December, 1926, and the results as reported by Sir Charles Parsons, are as follows:

	1	2	3
Boiler pressure, lb.....	520	543	502
Boiler temp. F.........	815	785	740
Uptake temp..........	616	558	523
R.p.m.	568.8	532.8	491
S.hp.	3480	2800	2083

The auxiliaries running were the circulating pumps, air pumps, feed pumps, forced lubrication pumps, forced draught blowers and dynamos. The latter absorbed about 100 amp. at 110 volts, which accounts for about 15 hp. At 30 lb. steam per hp. they would account for about 1.5 per cent of the total steam consumption. All other auxiliaries should be charged to the propulsion power plant.

The steam and water consumption results are as follows:

	1	2	3
Turbine, lb. water per s.hp.	8.01	8.38	8.72
Auxiliaries, lb. water per s.hp.	1.66	1.86	2.21
Turbines and auxiliaries..	9.67	10.24	10.93
Coal per s.hp. lb.........	1.08	....	1.17
Boiler efficiency..........	79%	....	80%
Ratio Turbine consumption..... Auxiliary consumption—	21%	22%	26%

On an oil fuel basis with the ratio:

$$\frac{18500 \text{ B.t.u.}}{13500 \text{ B.t.u.}} = 1.37$$

The fuel consumption figures are:

Oil lb. per s.hp. total	0.79	0.85
Oil lb. per s.hp. turbine ...	0.65	0.70

A more favorable result has been reported with a later ship, the rebuilt EMPRESS OF AUSTRALIA. In this vessel moderate pressures with a high degree of superheat—T° = 615—were used.

The results for this installation as given in London *Engineering* are as follows:

Fuel per s.hp. hour................	0.69 lb.
Turbines and propulsive auxiliaries, including steering engine—Steam per s.hp. turbines...............	8.3 lb.
Evaporation water per lb, fuel.....	13.4 lb.
Boiler efficiency	83%

The fuel consumption for turbines alone would be 0.62 lb. per s.hp. per hour, which gives a consumption for the auxiliaries equal to 11%, which when compared with the 21% for the KING GEORGE V. seems low. It is stated that the figure 0.69 lb. represents the fuel for the turbines and their auxiliaries, but does not include the deck auxiliaries.

In view of the fact that the steam from these two classes of machinery cannot be separated, it is probable that this figure is arrived at by estimating the consumption for the propulsive auxiliaries. In the case of the NELSON the steam consumption for the main turbines was about 8.4 lb. per s.hp. and about 9.6 lb. for all purposes. This gives a value of 17 per cent for the ratio of the auxiliary to the main turbine consumption. It is impossible to state what percentage of this should be applied to ship service auxiliaries, but it is well known that on trial trips the consumption for this purpose is not large. In the case of the INCHDUNE the equivalent oil consumption, for all purposes was 0.77 lb. per s.hp. In the case of the EMPRESS OF AUSTRALIA it is stated that "reducing these results to service conditions it means that in good weather the ship would be able to steam 19 knots with an aggregate consumption of 150 tons of fuel oil per day for all purposes." Since the shaft hp, at this speed will be about 17,000 the oil consumption will be about 0.82 lb. per s.hp. per hour.

From the above it is evident that there is doubt as to whether there is any real improvement in economy over the INCHDUNE. The difficulty of maintaining this result in service will certainly be much greater in the case of the EMPRESS OF AUSTRALIA, due to the higher temperatures used.

A more recent attempt at economy through the use of steam of high pressures and temperatures is the conversion of the reciprocatnig engine ship BORNEO.

The particulars are as follows:

Steam pressure	500 lb. sq. in.
Temperature	750° F.

On the trials of this vessel, "the coal consumed was weighed with great care, during the day of fair weather, so that the i.hp. could be kept practically constant, and it was found that the consumption worked out at 1.13 lb. per i.hp. per hour." The heat value of the coal used was 13,410 B.t.us.

From an examination of the foregoing data it is evident that there has been little, if any, improvement in steam machinery, from the standpoint of economy, in the past thirty years. The price paid in wear and tear due to the high pressures and temperatures will certainly be very high. The effect of these high values upon maintenance cannot be determined for several years. It is significant, however, that since the trials of the KING GEORGE V. in December, 1926, there has been no information forthcoming in regard to that vessel.

The foregoing examples are all from the merchant service, where the Diesel competition has had a very powerful influence.

High Pressure Steam

In the latest U. S. Navy vessels moderate pressure with no superheat has been adhered to. These vessels, which showed a consumption of about 0.9 lb. oil per s.hp., will require in service an increase of from 15 per cent to 20 per cent over this (1.03 lb. to 1.08 lb.), which will, as in all steam vessels, gradually increase with age.

The foregoing examples of modern steam plants, have been taken to represent the most advanced practice. In comparing Diesel economy with steam, it is necessary to do the

(*Continued on page* 861)

[1] Fuel value. coal. 13,500 B.T.U.S.—Oil, 18,500 B.T.U.S. Mechanical Efficiency. 92%

[2] With 92% efficient. which is moderate for a reciprocating steam engine, this figure would be 1.15 lbs. coal per i.hp.

Reorganization of Winton Engine Co.

A New Chapter in the Development of the American High-Speed Diesel Engine Industry

George W. Codrington
President

Alexander Winton
Chairman

ONE of the oldest builders of American Diesel engines has recently been reorganized. We refer to the Winton Engine Company of Cleveland. Incorporation papers were formally filed August 11th, 1928, under the laws of the State of Ohio, and the new company now owns all of the outstanding capital stock of the predecessor corporation of the same name.

The principal reasons back of the organization are the desire of some of the former officers to retire from their active participation in the conduct of the company's affairs, and the necessity for augmenting the company's facilities in order to handle the increasing volume of business.

In carrying out this reorganization the company's ample resources have been further strengthened by financial affiliations of a highly important and beneficial character. The high standing of Winton products and the continued growth and progress of the company are assured by the fact that the same men who have brought the company its present large measure of success will continue to conduct its affairs.

Alexander Winton, founder of the company, and for many years its president, now becomes chairman of the board of directors. Mr. Winton's career in the Diesel industry is well known. As a pioneer, inventor and mechanical engineer with many notable achievements to his credit, he occupies a foremost place in the list of those who contributed to the development of the high speed Diesel-type engine in this country.

George W. Codrington, former vice-president, is president of the new corporation. He will be in direct charge of the many activities pertaining to the designing, building and marketing of the company's products. Mr. Codrington's elevation to the position of chief executive is the logical result of his successful conduct of the company's business in the past ten years, during which time Winton products have been brought to their present outstanding position in their respective fields. Joining the company some ten years ago in quite a minor capacity, Mr. Codrington has worked up to his present executive position through sheer merit. The entire Diesel engine industry has watched Mr. Codrington's progress with interest and the company is to be congratulated, first, on having as its chief executive officer a man who so thoroughly knows his business.

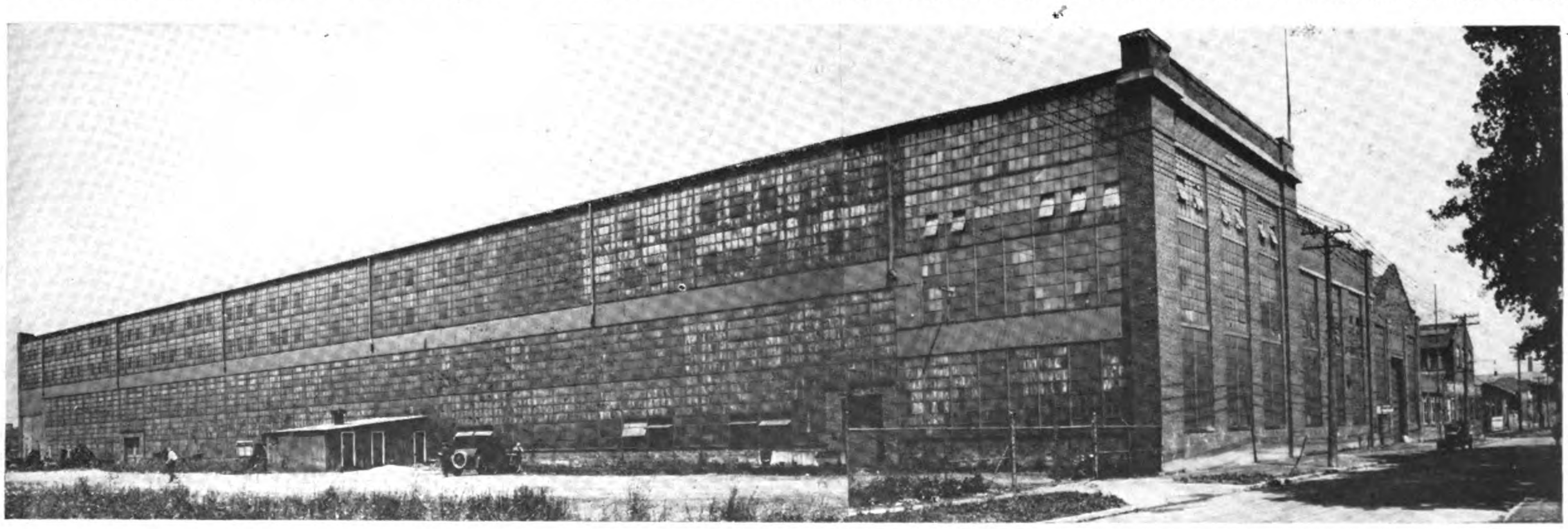
Another man who likewise has earned his spurs and who now becomes vice-president of the company, is Arthur G. Griese. Mr. Griese started with the company on his return from France immediately after the World War. Since that time he has actively represented the Winton Engine Company on the eastern seaboard. Knowledge of his activities in connection with the Winton Engine Company is wide-spread, and his friends in the business world are many. His knowledge of the trunk-piston Diesel engine and its application to the marine field is second to none.

The directors of the new company will consist of Alexander Winton, George W. Codrington, A. G. Griese and the following nationally and internationally known financial men: Frank H. Shaw, vice-president of John Burnham & Company, Chicago, Ill.; Ralph Hubbard of John Burnham & Company; I. F. Freiberger, vice-president of Cleveland Trust Company, Cleveland, Ohio; Howard Whitehouse, Continental National Bank, Chicago, Ill., and Sheldon Noble of W. Noble Company of Detroit, Mich. The officers of the company, in addition to Messrs. Winton, Codrington and Griese, consist of F. H. Shaw, vice-president; W. S. McKinstry, secretary and treasurer, and D. A. Lake as assistant treasurer.

The operating and sales personnel of the company remains unchanged. As in the past the company will continue to build marine and industrial engines, both Diesel and gasoline types, and the officers and staff will adhere strictly to the policy of maintaining the high quality of Winton products. The resources and affairs of the company were never in better shape, and the entire organization will continue to be maintained on the same high level of efficiency that has characterized it since the company's inception. It is interesting to know that unfilled orders now in process as of September 15th total more than two million dollars.

History of the Winton Engine Company

The growth of the Winton Engine Company is a typical American industrial romance, MOTORSHIP believes that a brief recapitulation of what this company has achieved will be of interest to its readers. It was eighteen years ago that Alexander Winton in looking around for suitable marine gasoline engines for his motor yacht "La Belle" decided that the market then afforded nothing completely satisfy-



An impressive view of the Winton Engine Co. plant at Cleveland, Ohio.

ing his needs. So he decided to design and build three engines for himself, which he did, these engines having six cylinders, 9 in. x 12¾ in. each, rated at 150 hp. These engines were so successful that a number of his friends insisted that he build some for them. Consequently, early in 1912 the Winton Gas Engine & Manufacturing Company was organized and incorporated under the laws of the State of Ohio. Shortly after the formation of the company, that is to say, late in 1912 and early in 1913, three Winton marine gasoline engines, known as the Models No. 11, No. W 5 and No. W 6, were brought out. These three models without a single major change in design are still being built, sold and used successfully more than fifteen years after they were designed and built for the first time. All of them are six-cylinder engines of the four-cycle type.

In the fall of 1913, the first Winton Diesel engine was completed. This engine was probably the first all-American Diesel ever built and its successful use in an industrial power plant for many years has fully justified Mr. Winton's early decision to strike out along original lines in developing Diesel engines for the American market instead of following practices then prevailing in Europe.

During the war, two new Winton gasoline engines made their appearance. These were the Models W 28 and W 29. The W 28 was a six-cylinder unit, with 6½ in. bore, 9 in. stroke, developing 150 hp. The W 29 was an eight-cylinder, with the same bore and stroke as the W 28 and developing 200 hp. A large number of these two models were sold to the American and Russian governments for use in mine layers and river vessels.

At this time the company also developed the Model W 35. This was a six-cylinder Diesel unit, with 11 in. bore, 14 in. stroke, developing 225 hp. A number of these engines were sold to the Italian government for war service.

In 1915 the company produced what was probably the first V-type twelve-cylinder Diesel engine ever built. This was known as the Model W 30. Two of these engines were installed in the "La Belle," replacing the three six-cylinder gasoline engines with which she was originally powered. In 1916, the Model W 24, a six-cylinder Winton Diesel marine engine was produced. This engine had a bore of 12-15/16 in. and a stroke of 18 in., and developed 225 hp. It was the first Winton engine designed strictly for workboat service, and was installed in such ships as the ESPERANCA, PECHENEY, ADRIEN BADIN, CHARLES GAWTHROP, SHERWOG and ERRIS. Shortly thereafter followed the Model W 40, an eight-cylinder Diesel with the same bore and stroke as the Model W 24, and developing 500 hp. Engines of this type were installed in the ships MT. BAKER, MT. HOOD, MT. SHASTA and JAMES TIMPSON.

Since these early installations the company has enjoyed a steady substantial growth and today is a recognized leader in its field. From the beginning of 1918 the Diesel end of their business has increased greatly from year to year. Today many of America's finest yachts and work-boats are powered with Winton Diesel engines, and their range of usefulness is constantly broadening. The gasolie engines, too, have kept pace—not only in the development of the units themselves but also in their highly successful application to the diversified classes of service for which they are designed and built.

An abundance of natural light aids in the work of assembly

One of the most important factors in this steady substantial growth is the Winton Engine Company's liberal service policy. Users of Winton engines are assured of competent, willing assistance when needed, to the end that their Winton power plants may be, in every sense, a complete success. The company's resources and standing permit a character of attention to their products after they are placed in service that is extremely valuable to the users of Winton engines.

The company has found it desirable to engage in the manufacture and sale of auxiliary equipment, such as generator sets, air, fire and bilge pump sets, air compressors and tender engines.

The shop organization is high grade and efficient—most of the men have been with the company for many years and work together smoothly and harmoniously and the labor turnover is small. The company is justly proud of the men in its shops.

Plant and Equipment

Located on the New York Central Railroad, in the western section of Cleveland, the plant is one of the finest of its kind, both as to the structure itself and its equipment. The entire plant is of the daylight type, steel and glass with fireproof roof and sprinkling system. The various equipment units are up-to-the-minute in design and of proper size to permit of efficient and economical production. All machine tools, planers, horizontal and vertical boring mills, grinders, lathes and drill presses are modern and in first-class condition. We have spent many an hour watching the Diesel engines in their different stages of manufacture.

The various departments of the plant and their equipment units are so arranged that all materials pass through the plant in proper sequence, minimizing handling and insuring speed and economy in production.

Machine Shop

The machine shop occupies two of the four main buildings and covers a floor space 130 ft. by 300 ft. Between the two machine shop buildings are located the water test department and forge, with adjacent heat-treating room. In one end of the machine shop is the rough stock room including receiving room. The other two main buildings are occupied by the assembly department, 100 ft. by 360 ft., and at one end of one of the assembly floors is the finished stock room, and above this is located a modern, well-lighted engineering department and drafting room. Separate buildings are given up to the pattern shop, boiler house and sand blast house. Each of the main buildings is equipped with a crane travelling the entire length of the building and also numerous stationary jib cranes.

Rough castings requiring hydraulic test are sent to drill presses, from which they go to the water-test floor, and from there to the layout tables; castings not requiring water-test go direct to the layout tables. Heavy

A section of the plant devoted to test and shipment of Winton Diesels

Convenient arrangement of tools is revealed in this view of the machine shop

castings, such as bases, bed plates, frames and cylinders, go from the layout tables to the planers. From the planers, these castings are moved by travelling cranes to the radial drill department; here the parts are drilled and tapped, and due to efficient arrangement of machines, unnecessary handling and moving by crane is eliminated. A battery of Lucas mills do practically all the boring and milling. These machines, as well as the numerous milling machines, engine lathes, cylinder grinders, gear hobbers and shapers, vertical mills, screw machines and drill presses are arranged to the best advantage, in order to expedite production. The machine shop throughout is equipped with the latest types of special tools, each designed especially for accuracy and speed in performing its particular work in connection with Diesel construction.

From the drills the bases are sent to the horizontal-spindle boring mills and bearing-seatings for a whole base are bored at one chucking, so that bearing-seatings are in perfect alignment.

Assembly Department

The assembly department is so arranged that all work can be performed with minimum effort. Heavy parts are carried direct to the various units on which they go. Smaller parts are assembled on side floors, from where they are carried, either by jib or travelling crane to the engines as they are erected.

Each unit, when completely assembled, goes to the testing floor, where it is given a most careful inspection, and is required to undergo a prolonged run at full horsepower rating. Slots are provided on stands on test floor, so that the engines can be bolted to the test bed at any place. Cooling water for engines under test is supplied by means of trenches and tunnels, which also furnish and take away the water from the hydraulic dynamometers, on which all Winton marine engines are tested. After each unit has passed its test, it is painted and then loaded aboard the railroad car. All Winton engines are shipped set-up, thereby assuring proper adjustments upon delivery at destination. Loading platforms are on the N. Y. Central Railroad tracks, which run into the shipping room, located at one end of one of the assembly floors. Shipping facilities are ideal, and the entire plant operation is in accordance with modern practice.

Diesel Engines for Naval Vessels

(*Continued from page* 858)

same thing. The difficulty, however, is that the oil engine is progressing so fast that it is difficult to say what its best performance is.

The best published Diesel record to date is that of the Hesselman—A. E. G. airless-injection two-cycle engine, which is reported to have shown a fuel consumption of 0.352 lb. per b.hp. per hour, without the scavenging blower. With the blower the consumption will be about 0.375 lb. In smaller engines appreciably better results have been obtained with airless-injection and it is quite certain that the difficulties of airless-injection in large engines are being overcome, and that we may look for very material improvement. The ultimate goal towards which engineers are working is about 0.3 lb. per b.hp. per hour, and it is quite certain that before the Diesel engine has reached the end of the development, now in its beginning, a close approach will be made to that figure. It is yet too early to say what form this engine will take.

With small airless-injection engines values of fuel per s.hp. of 0.36 lb. have been obtained by Hesselman, Deutz, Augsburg and Chorlton. In larger engines which should show a materially higher economy, difficulty of adequate fuel distribution, with the low penetrating effect of airless-injection, has been experienced. These difficulties are being overcome, and it is quite certain that in the near future values of fuel per b.hp. better than 0.35 lb. will be reached.

The next step will probably be made by the use of a high degree of supercharging and a higher compression pressure, in combination of some form of exhaust gas turbine.

In the merchant service the question of fuel cost is an important, though not always a controlling factor. In the case of naval vessels (and to some extent in the case of liners), the conditions are such that a return to coal is impossible. The Navy is irrevocably committed to oil, and it is obvious that the higher the cost, and the smaller the quantity available, the greater will be the advantage of the most economical method of using it.

The purpose of this article, as stated, has been to attempt to justify a belief in the practicability of the Diesel engine for light-weight high power installations. The desirability of such an installation is self evident.

There is one point which bears upon its availability which merits a few words. Is it reliable? The experience of the last ten years has provided a wealth of information upon this point, but the answer can best be given in the words of an eminently qualified authority, Lord Inchcape, writing to the *Evening News* states: "The AORANGI, 17,500 tons, of the Union Steamship Co. of New Zealand, has been in the mail service between Vancouver and New Zealand since January, 1925, a period of two and one-half years, and has caused her owners not a day's anxiety, running at 18 knots, or more, with unfailing regularity."

A New Pacific Coast Diesel Engine

By Harold F. Sherwood

IN an endeavor to excel its reputation gained through many years of producing the noteworthy Frisco Standard Gas Engine, the Standard Gas Engine Company, Oakland, Cal., has now in course of construction an ultra-modern Diesel.

The officials of the company announce that this Diesel has advanced features of design based upon the company's extensive background in gas engine experience, and the combined experience of European and American Diesel engine practice. Their gas engine experience has taught the needs of the customer, and it has also revealed the requirements of service conditions and installation demands.

The Standard Diesel follows the ultra-modern tendency in clean-line design. In outward appearance it has simple and smooth-flowing surfaces. The entire engine has a symmetrical structure which completely houses all moving parts. The framing is so designed as to concentrate stresses within a small radius of influence, thus making possible light weight construction of great strength. All moving parts are lubricated by force-feed and every auxiliary unit is contained within a single enclosed housing. This construction gives a neat and clean appearance. Moreover, it conserves lubricating oil and assures positive lubrication without attendance.

The detailed parts are designed under the influence of automotive manufacturing in order that production methods and standardization practice can be used to reduce first costs. Many of the small parts entering the construction of the engine, are being manufactured in automotive specialty plants.

The officials of the Standard Gas Engine Co. also declare that the materials have been selected to render parts best suited for the service for which they are intended. All principal castings are alloyed to provide wearing surfaces, tensile qualities or heat-resisting properties as may be desired in each particular case. Controlled methods of heat treatment and material processing, have been carefully supervised.

The operator has been carefully considered. Accessibility of parts and ease of adjustment have been accomplished in a highly satisfactory degree. Every agency has been provided to reduce maintenance costs.

The fuel system has been designed to facilitate flexibility of control and to give clean combustion at any load or speed within the operating range of the engine. Safety devices have been incorporated to prevent injury to the engine in case of accidental water stoppages or lubrication emergencies and gives added assurance of dependable operation.

Diesel Achievement by Sulzer

(*Continued from page* 856)

second degree is near the middle of the engine, so that the resultant 10th order is very small and the additional stresses are also very slight.

Apart from the critical speed caused by the irregularity of the propeller resistance, the order of which is determined by the number of blades, the three single-acting Sulzer two-cycle engines already mentioned as designed for passenger liners, are practically free from vibration over the whole range of maneuvering and service speeds.

Sulzers are of the opinion that there is in double-acting engines as hitherto constructed, quite, or partly, independent of possible torsional vibrations of the shafting, a dangerous cross-vibration of the engine in the plane at right angles to the shaft. This vibration arises when the reversal in pressure on the crosshead guides synchronizes with the natural period of vibration of the system. In the single-acting two-cycle engine, the frame is rigid enough and the centre of gravity is low enough to keep the natural period of vibration of the system well above the impulse figure, so that this vibration has never yet occurred on any Sulzer-engined ship. The zone of critical vibration lies safely above the maximum working speed; the engine, whether it has four, six, eight or ten cylinders, stands absolutely steady and no loosening of the foundation has ever occurred.

Another claim made by Sulzer's engineers is that in double-acting engines the reversal of pressure at each stroke causes also a hammering of the crankshaft on the main bearings. The knocking of the many heavy masses, which are to a certain extent tossed up and down in the many bearings, combines into a noise, which is readily transmitted through the steel structure of the ship and can be heard in the farthest cabin. The play in the bearings cannot be reduced so far as to make knocking an impossibility, as that would endanger the reliability of working.

An important point! With regard to the health of the engine-room staff, no noxious gases can find their way into the engine-room. Below the ports the piston is rendered gas-tight by rings springing inwards so that any gas which may have managed to pass the upper piston rings must leave through the exhaust ports. In addition to that, fresh air is continuously passing through the clearance space between piston and cylinder.

Any overhaul can be carried out on a single-acting Sulzer two-cycle engine in the shortest time imaginable. On the motorliner AORANGI a damaged piston was replaced at sea by a new one in five hours, while the other three engines continued to work.

Diesel Tug Gives Good Account of Herself

The B. M. Thomas Replaces Two Steam Tugs and Operates More Cheaply Than One

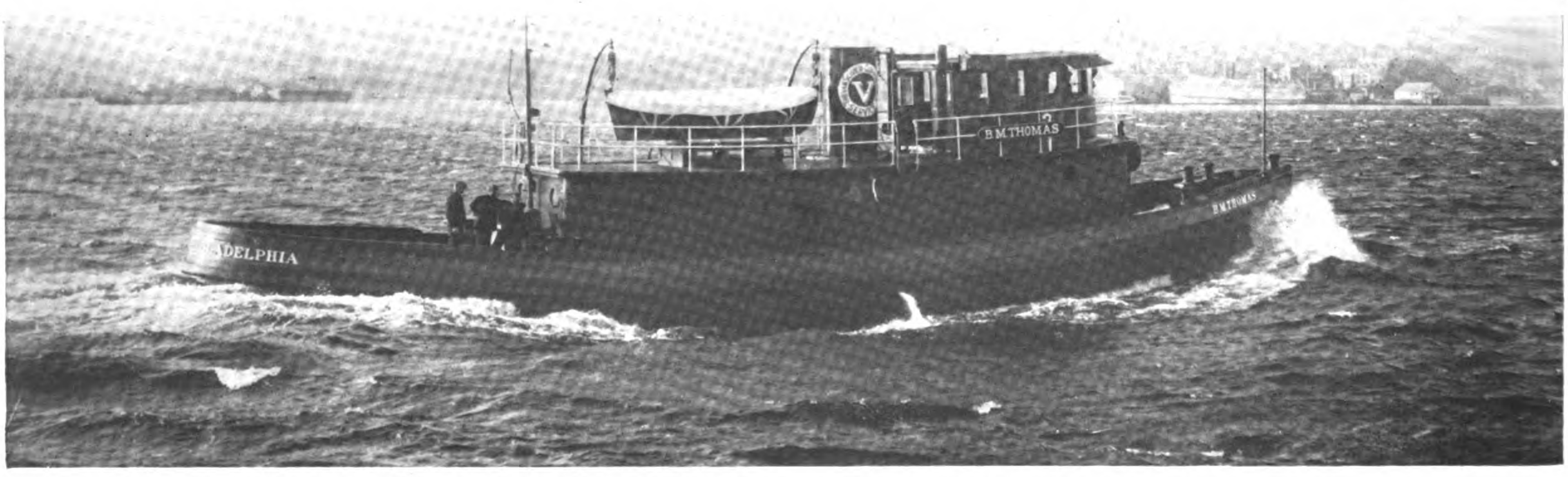
WHEN Captain Charlie Darby, master of the B. M. THOMAS was asked recently about her performance he replied "She was rung-up the first of January, 1927, and hasn't stopped since." While such, of course is not literally true it is almost a fact. Her regular trip is from the Delaware side of Philadelphia down to League Island and up the Schuylkill side to Fairmont Dam, and back to her starting point, a total distance of about forty miles. She makes this trip, towing from five to seven deck scows, each carrying from five hundred to a thousand tons of cargo, every tide during six days of the week. She has been on this schedule regularly ever since she was delivered to her owners, by the New London Ship and Engine Company in December, 1926. There has not been an hour of lost time caused by engine trouble; in fact she has always been ready to go except during the regular winter overhaul.

Performance such as this is so characteristic of Diesel tugs as to rob the B. M. THOMAS of any claim to exclusiveness and it was started so long ago as to rob her of originality. On the other hand it is an enviable record; one that could not be attained with a Diesel tug, or any other kind of tug, unless she were properly managed and operated. Her owners the Hainesport Mining and Transportation Company of Philadelphia, are justly proud of an achievement which includes not only an excellent operating record but the working out of constructional details which have made the tug exactly suited to their requirements. They frankly admit that they are sold to Diesel power and that no more H. M. & T. Co. steam tugs will grace the Delaware and Schuylkill rivers.

B. M. Thomas digging out a tow

Before deciding to build the B. M. THOMAS their business had outgrown a steam tug that had served them well, notwithstanding the very high cost of her operation. Thereafter they found it necessary to use two steam tugs because a single one large and powerful enough to do the work could not pass under the bridges or navigate the upper reaches of the Schuylkill on account of her height and depth. They had a large tug available and they tried to make her do the work by cutting off the stack so she could pass under the bridges. Thereafter she refused to steam and the smoke not only blinded the pilot but made life unlivable aboard for the entire crew. She was so deep that when she was caught up in the shallow parts on low tide she went aground and lost valuable time.

After a sufficient number of demonstrations of the impracticability of successfully operating a large steam tug the company decided to investigate the possibilities of Diesel power. A careful study of



This powerful little Diesel tug goes hurrying about her business of doing the work of two steam tugs.

the subject led them to believe that they could use it in a tug capable of navigating these waters and powerful enough to do the work of two small steam tugs.

At first they thought it would be necessary to use a clutch and gears on account of the large number of maneuvers necessary in making up tows, before starting the trip, and maneuvering at the numerous landings and pick-ups on the far end. Besides this they needed flexibility. It was said a Diesel boat would "tear off cleats, break lines and make trouble generally" in getting under way or in docking.

Records were kept on their steam tugs and it was found that frequently as many as 150 starts were made about as quickly as the bells could be pulled. This made it appear that there would be no chance to replenish starting air on a Diesel tug except with the auxiliary compressor, and they did not favor that scheme. On the other hand it would require some 25 ft. more length of hull to accommodate the clutches and gears under consideration. It would also entail an additional expenditure of several thousand dollars to obtain a vessel of equal power.

Diesel Proves Equal to Maneuvers

The greater cost was not the only determining factor; a small hull, they knew, would be more suitable for work in shallow water and in maneuvering around the terminals and bridges. After taking all things into account they decided that the best plan would be to use a directly reversible Diesel.

After reaching a definite decision on all matters of major importance it only remained to proceed with the design and to work out the minor details. The final result was a hull 88 ft. 9 in. in length, 21 ft. beam and 10 ft. draft, with less than 23 in. of freeboard. A six cylinder, four cycle, airless injection Nelseco Diesel with a rated speed of 320 r.p.m. was chosen. An air compressor for pumping maneuvering air is attached to and driven by the engine and a 5 kw generator is also attached to, and driven by it. Thus power from the main engine operates the electric steering gear, electric capstan, refrigerator, oil purifier, the engine room pumps and the lights. Storage batteries are installed to float in the line and supply current at peak load periods and to light the vessel when the main engine is not in operation.

By this arrangement it is possible to operate the B. M. THOMAS by means of the main engine alone, except when more maneuvering air is required than can be supplied by the attached compressor. To obviate the possibility of a shortage of maneuvering air or auxiliary power an 18 h.p. Diesel, direct connected to an emergency compressor and 4 kw generator has been installed. In order to bridge the long spaces of rapid maneuvering without having to start the emergency compressor two banks of starting air bottles were installed, but it is seldom necessary to cut in the second bank and there has never been a time when there was not ample air, and so it is evident that "lack of flexibility," of which they had heard, is only a bugaboo. The B. M. THOMAS is easy on cleats and lines.

Naturally the Hainesport people's enthusiasm results from the fact that they are able to accomplish something with a Diesel tug which was not possible with a steam tug.

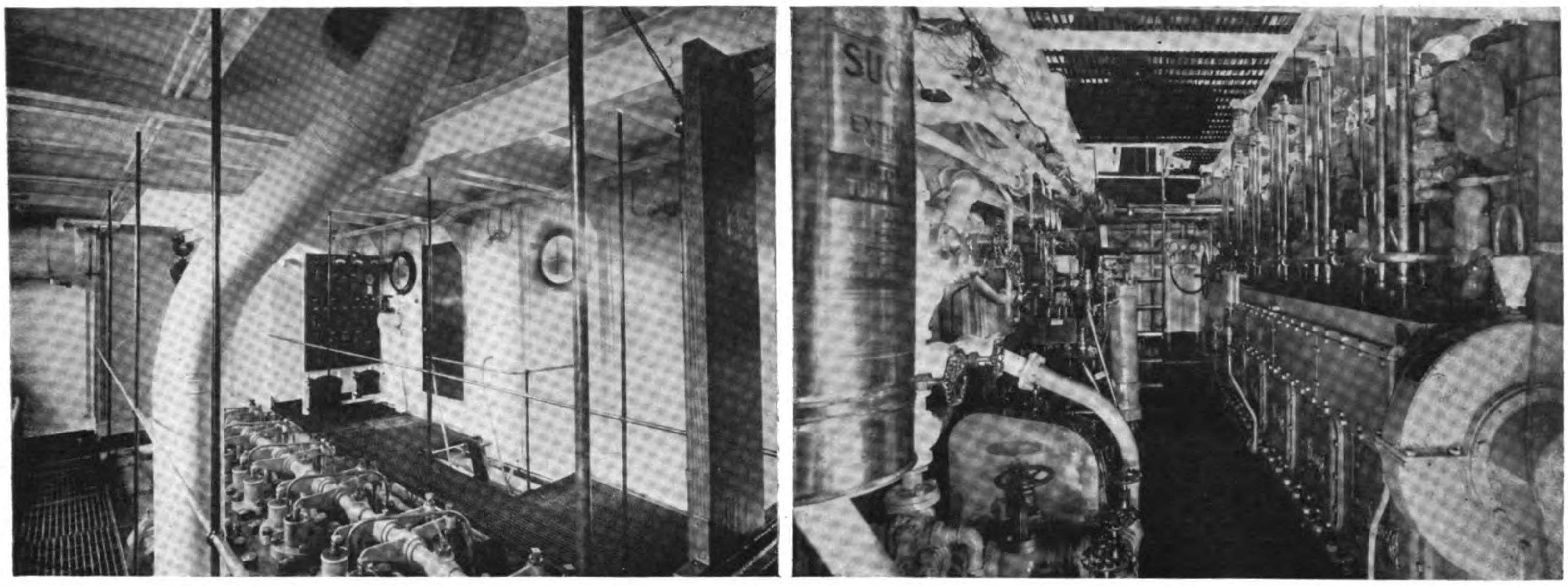
Does the Work of Two Steam Tugs

Basing the estimate on steam practice the B. M. THOMAS is in fact a 500 horse power boat with a size 250-horse-power hull. This doubles the work accomplished by one crew, and makes it possible for the owners to do their Schuylkill river work with but one Diesel tug.

With the usual tow of five to seven loaded deck scows she moves down the Delaware, with the ebb tide to help, and the real struggle comes when she turns into the Schuylkill and bucks tide up the river with her heavy load. The scows are frequently consigned to different wharves and to distribute them it may require 150 starts of the engine in an hour and a half. Seven or eight light scows may have to be picked up quickly in order to save the flood tide up the Delaware to the starting point. Sometimes she does it with a couple of hours to spare. Whereas her predecessors frequently reached the mouth of the Schuylkill after the tide had turned ebb in the Delaware. Then she had ten miles of ebb tide to stem which meant disaster to the next trip as well as delay to the one in hand. It was no better with the big steam tug because delays frequently occured at one or more of the bridges.

No Engine Delays

The owners have found mechanical troubles with the B. M. THOMAS to be neglible. Their dispatcher rarely knows when necessary adjustments are made, they are done so quickly. She carries a spare exhaust valve, and each week or ten days it is used to replace a valve in service. The valve taken out is then overhauled and made ready for the next replacement. By this routine method of overhauling a complete change of exhaust valves is made about once in two months, and the intake valves run six or eight months without requiring attention so the work of keeping the engine in condition is not great.



A neat and compact Nelseco installation that is a credit to the builders and the owners of the B. M. Thomas.

Owners Well Pleased

The owners lay claim to a saving equal to the cost of operating one steam tug because of better adaptability of the Diesel to the specific job of the B. M. THOMAS. The steam tug of 350 h.p. which they had tried to adapt to the work and which did not work out because of her draught and her stack height, required not less than three hours per week to fuel and twenty-four hours per month for boiler washing. The Diesel boat requires one hour per month to fuel and no boiler washings. The net saving in time for a month amounts to thirty-six to forty-eight hours. The coal burner required three firemen while the Diesel tug requires no firemen; although she carries an oiler on each watch who also helps with the lines when necessary. She does her work at a net saving of 20% under the next best showing of the steam tugs and with an advantage of 75% under their least economical steam tug. The saving would be greater if their boats did not operate practically continuously, because the stand-by losses with a Diesel are nil.

Table of Relative Fuel Costs

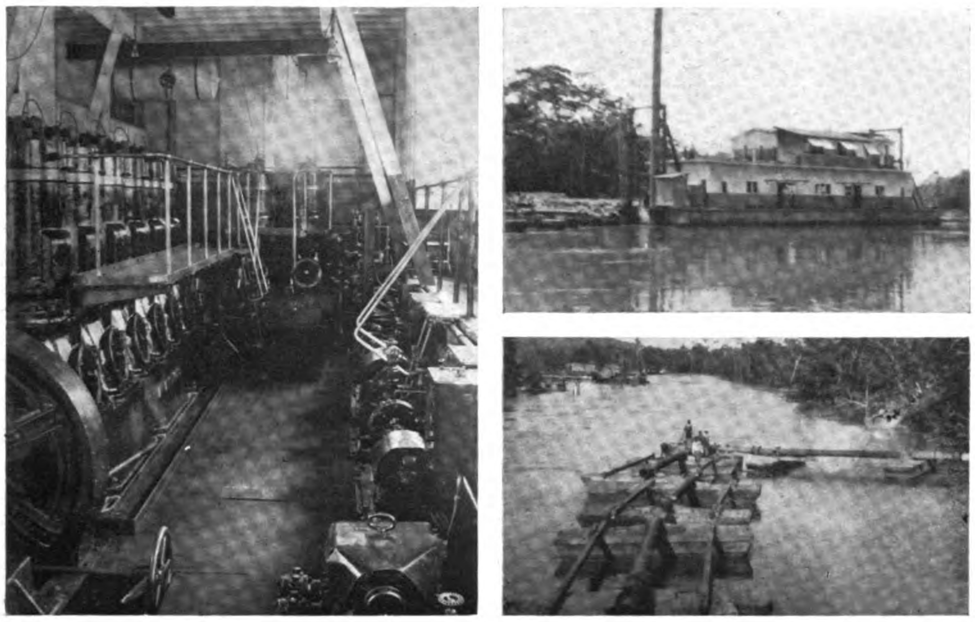
	Fuel per month 24 hr. operation	Total fuel costs	Per h.p. month
Diesel 500 h.p. .... gals.	5,000	$250	$0.50
Steam 350 h.p. (Coal)* .. net tons	200	1,200	3.20
Steam 750 h.p. (Oil) .... gals.	5,500	1,500	2.00

* The company transports its own coal from its own hoppers and so avoids the delays resulting from trips to coaling piers.

Diesel Dredge Operating in the Tropics

At work on the Orinoco River in Venezuela the dredge BLANK "has consistently done good work," writes Thorwald H. Hansen, the chief engineer. In support of this he sends us two pictures of the dredge at work, and a very good interior view of the engine room.

The BLANK is a 16-ft. hydraulic pipe line machine of the cutter type, with a single sand pumping outfit. The pumping machinery consists of a centrifugal pump direct connected to a 360 hp. Fairbanks, Morse oil engine. The auxiliary machinery is electrically driven from an oil engine driven generator mounted on the dredge. Feeding into cut is by means of wire rope haulage on each side of the bow, with pivoted stern, and the advance forward is accomplished by two spuds. The hull is built of wood, 110 ft. long, 34 ft. beam, 7 ft. deep, with a mean draft of about 3 ft.



As evidence of her serviceable and well kept condition the chief sent some pictures

Built complete at Baltimore by the Ellicott Machine Corporation, she was delivered by towing to her original destination, which was Florida. Subsequently she was towed to Guanoco, Venezuela, arriving there 48 days after leaving Tampa in July, 1927.

First she dredged a 1200-ft. channel 100 ft. wide and 20 ft. deep, at mean low tide, alongside of the docks. Then she started working down the Guanoco River opening a channel 100 ft. wide and 15 ft. deep, at mean low tide. Rise and fall of tide in the Orinoco River at this point is about 10 ft.

In July she was working in the Orinoco delta, where the banks of the river are swamps. Quite a bit of trouble was encountered by roots in the suction pump and the discharge line. It was found necessary to open the pump about six times a day to dislodge stumps and other obstructions.

The river is very muddy, which makes it necessary to wash out the water-jackets every day to prevent them filling up with mud. All repairs are done aboard the dredge in a small machine shop; included in the shop equipment is an acetylene welding set. She is manned by a native crew. The only white men aboard are the captain and the chief engineer. We are indebted to the latter for the information here given.

Diesel Workboats On the Pacifie Coast

The Harbor Boat Building Company, of Terminal Island, California, has laid the keel for an 80-foot, Diesel-driven, deep-sea cruiser for Joseph F. Logel, of Los Angeles. The make of engine has not been specified.

The United Engineering & Drydock Company has purchased the Hanlon Shipyard, of Oakland. The Hanlon plant, which achieved wide reputation during the World War, will be used largely for the construction and repair of motor-driven workboats, cruisers and small steamers, while the United yard will continue building and repairing larger vessels.

The California State Fish and Game Commission has asked for bids on a patrol cruiser, 100 ft. long, sea-going, capable of caring for a minimum of ten men, for which $60,000 has been appropriated by the finance department of the commission. Building is to be started at once, with delivery early next year. Power is to be two Diesel engines, make not yet specified.

The FUNCHAL, a new fishing boat of wide construction, 110 feet long, has just been completed by Nunes Brothers, Sausalito, California. She is equipped with an Atlas-Imperial Diesel of 350 b.hp. and has an ice plant with a capacity of 8 tons of freezen fish. The new owners, Corriea & Corriea, will operate the FUNCHAL out of San Diego in the tuna fishing trade. Cost of construction is approximately $75,000.

W. B. Nichols, well known San Francisco Yacht Club member, recently purchased the motor yacht PETREL. She is a craft 60 feet long and is powered with a 100 h.p. Diesel. Mr. Nichols proposes to make a trip to the South Seas with this vessel next summer.

A record inland-waters voyage was made by the Diesel tug ACTIVE, of San Francisco, late in August, when she towed a floating piledriver, weighing about 100 tons, more than 100 miles across San Francisco Bay and up the San Joaquin River to Middle River, near Stockton. ACTIVE was built in 1912 and has been active on the bay ever since, under the able handling of her owner, Harry Johnson. In November, 1914, when the steamer HANALEI was driven on Duxbury reef with large loss of life, Johnson took ACTIVE out at imminent danger to his own life and saved twelve of those on board the steamer.

The CATHERINE PALADINI, newest addition to the fishing fleet of A. Paladini, Inc., of San Francisco, was recently delivered to her owners by the General Engineering Company of Alameda. She is the largest vessel of her kind plying out of San Francisco Bay waters, measuring 78 ft. x 8 ft. 7 in. x 7ft. 6 in. draft. Her main power plant consists of a 200 hp. Atlas-Imperial Diesel; and for auxiliary work she is equipped with a two hp. engine of the same make. With a fuel capacity of 2400 gallons, she will be able to remain outside for a week or more.

The CATHERINE will replace the HENRIETTA PALADINI, which was burned several months ago, and will engage in the sole and halibut trade outside the Golden Gate.

The William Cryer yard at Oakland, California, is building a 72-foot purse-seiner for the K. Hovden Company, of Monterey, for use in the sardine fisheries at that port. This is MARIPOSA II, sister ship to the NEW ADMIRAL, recently described in MOTORSHIP as built for the same company by the Anderson & Cristofani yard at San Francisco. The Hovden Company is having a third boat built at San Diego for the tuna fisheries off the Mexican (lower California) coast. This ship is to replace SUPERIOR, a tuna boat lost recently on the run from San Diego to San Pedro. Details of the San Diego boat are not yet available.

Small power driven air compressors are built in one and two stage types with capacities of from 10 to 21 cu. ft. of free air per minute, by the Rix Company, Inc., of San Francisco, Calif. These are very sturdy little machines, designed to supply starting air for oil engines on land and aboard small vessels.